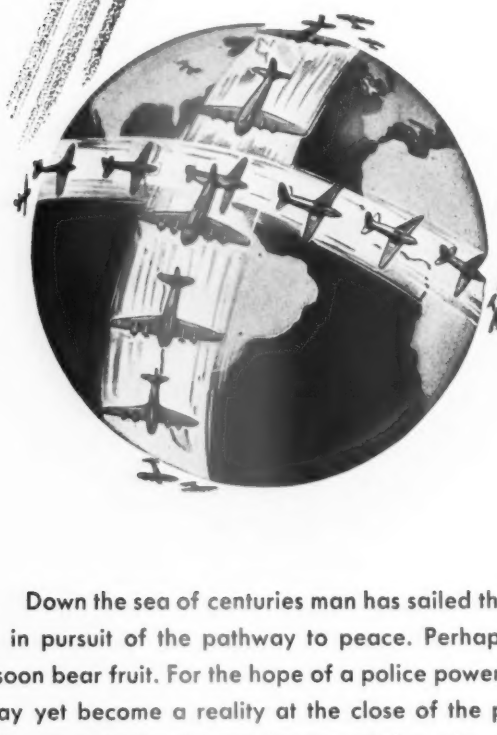
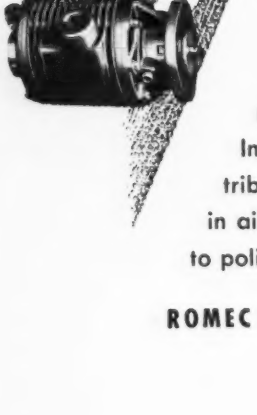
AERONAUTICAL ENGINEERING REVIEW

EPTEMBER 1943

POLICE POWER FOR *Peace...*





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Aeronautical Engineering Review: United States and possessions, 1 year, $3.00; single copies, $0.30. Foreign countries including Canada (American Currency Rates), 1 year, $3.50; single copies, $0.35.

Journal of the Aeronautical Sciences: United States and possessions, 1 year, $7.00; single copies, $2.00. Foreign countries including Canada (American Currency Rates), 1 year, $9.00; single copies, $2.50.

Entered as second-class matter at the Post Office, Easton, Pa., April 29, 1942. Acceptance for mailing at a Special Rate of Postage as provided for in the Act of August 24, 1912.

Publication Office: 20th & Northampton Streets, Easton, Pennsylvania.

Editorial Office: 1505 RCA Building West, 30 Rockefeller Plaza, New York 20, N. Y.

Notices of change of address should be sent to the Institute at least 30 days prior to actual change of address.

Statements and opinions expressed in the Aeronautical Engineering Review are to be understood as individual expressions and not those of the Institute. Permission is given to reprint any article after its date of publication provided proper credit is given.

CONTENTS

Cover Illustration: Flying Fortress tail sections ready for assembly. Photo by Office of War Information.

Articles

Technical Functions and Responsibilities of the Civil Aeronautics Administration . . William A. M. Burden 7

The Airport Program.....**Charles B. Donaldson** 7
Airways Engineering.....**L. M. Hammond** 11
Radio and Land-Line Communications.....**Eugene Sibley** 15
Signals.....**Howard S. Stokes** 16
Air Traffic Control.....**Glen A. Gilbert** 21
Aircraft Engineering.....**A. A. Vollmecke** 27
Flight Engineering and Factory Inspection.....**Charles F. Dycer** 33
Technical Development.....**Joseph C. Hromada** 33
Human Engineering in Aviation.....**Dean R. Brimhall** 36

Reviews

Periodicals 41

Government Publications 97

Books 103

Aircraft Electrical Systems
Vertical Warfare
The War Plane and How It Works
America's Navy in World War II
Introduction to Sea and Air Navigation
Astronomical Navigation
Aircraft and Engine Mechanics' Manual
Mathematics of Flight
The Chemical Background for Engine Research
Basic Mathematics for Aviation
Manual for Aviation Cadets
Aerology for Pilots
A Pre-Flight Aeronautics Workbook
Metals and Alloys Data Book
1000 Pre-Flight Problems

House Organs and Catalogues 121

From the Industry 131

Institute News 153

British Air Ministry Translations in The Paul Kollsman Library 115

Index to Advertisers 169

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1924

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Technical Functions and Responsibilities of the Civil Aeronautics Administration

WILLIAM A. M. BURDEN*

William A. M. Burden.

THE CIVIL AERONAUTICS ADMINISTRATION is primarily an operating and not a policy-making agency. Federal policy in the field of civil aviation is determined by the Civil Aeronautics Board, composed of five members. It is the function of this independent and quasi-judicial Board to grant certificates of convenience and necessity to air-line operators, regulate air-mail and passenger rates, formulate civil air regulations for the greater safety of pilots and the general public, and lay out broad lines of policy for the development of aeronautics.

The Civil Aeronautics Administration is charged with carrying out and enforcing the policies laid down by the Board. Since 1940 the Administration has been a bureau of the Department of Commerce, directly under an Assistant Secretary of Commerce, thus obtaining Cabinet representation. By the act of its creation the C.A.A. is not only empowered to establish civil airways, landing areas, and other air-navigation facilities but in general is "to encourage and foster the development of civil aeronautics and air commerce in the United States and abroad."

Under Charles I. Stanton, Administrator, the C.A.A. operates through four main divisions: Federal Airways; Airports; Safety Regulations; and the War Training Service, formerly the Civilian Pilot Training Program. At the present time it has approximately 10,000 employees, more than 8,000 of whom are in the field engaged in operating the airways and other technical services. At the request of the Army and Navy a considerable number of C.A.A. technicians have been sent to Alaska, our island possessions and bases, and to foreign shores to assist the military air forces in pioneering and maintaining a maze of global skyways along which our fighter and transport craft are flying day and night in ever increasing numbers to our far-flung battle fronts. Domestic airways alone total 35,000 miles.

Charles I. Stanton, Administrator.

The character, scope, and great variety of technical and engineering functions performed by C.A.A. are clearly indicated in the sections of the article which follow, each by an expert in his field.

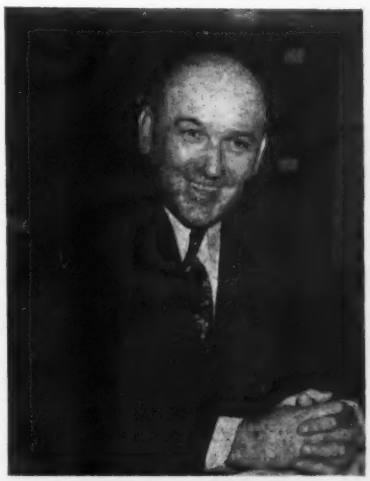
* Special Aviation Assistant to the Secretary of Commerce.

The Airport Program

CHARLES B. DONALDSON*

THE AIRPORTS SERVICE of the Civil Aeronautics Administration is charged with fostering airport development throughout the United States, its territories, and possessions.

This Service plans and coordinates all civil airport development and correlates these plans with those of the Army, Navy, and other Federal agencies. It recommends the allocation and supervises the expenditure of funds appropriated for airport development, and determines the necessity for all other Federal expenditures for civil airport development. It supervises and directs the C.A.A. airport program now engaged in the construction of public airports essential for the prosecution of the war. It prepares and distributes to Federal agencies, states, cities and other civic bodies, typical airport plans, designs, specifications, and bulletins pertaining to the planning and construction of airports. It reviews civil airport project applications, plans, and specifications involving the expenditure of Federal money, and processes certificates of necessity for such development in accordance with Section 303 of the Civil Aeronautics Act. It collects and maintains current information on all civil airports in the United States. It conducts studies on airport zoning and advises on legal, financial, and engineer-



Charles B. Donaldson.

* Director, Airports Service.

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ing matters concerning civil airports.

The Airports Service is divided into three principal units—the Office of the Director of Airports, the Planning and Survey Section, and the Engineering and Construction Section.

Planning and Survey

The Planning and Survey Section formulates the national airport development plan in cooperation with other divisions of C.A.A., the Civil Aeronautics Board, and other Federal and State agencies concerned. It periodically determines and recommends what portions or units of the national plan shall be improved or developed. It prepares future airport appropriation estimates, collects and distributes detailed information on existing airport facilities. It conducts preliminary surveys and compiles information on airport development, management, operation, and maintenance for the information and guidance of civic planning groups.

Engineering and Construction

The Engineering and Construction Section directs, coordinates, and supervises engineering activities in connection with airport construction projects. This Section maintains liaison with Federal and other agencies engaged or interested in airport design and construction. It prepares and executes agreements between the C.A.A. and other Federal construction agencies engaged in airport construction. It reviews all civil airport applications, plans, and specifications which involve the expenditure of Federal funds, and recommends appropriate action. It prepares for general distribution designs, plans, specifications, and standards for airport and seaplane base development. It studies and recommends paving, lighting, and building design standards and construction practices, and maintains consulting engineering services for public officials and other individuals interested in airport development.

The National Defense Airport Program

Since the advent of war the efforts of the Service have been devoted entirely to the National Defense Airport Program under which more than 550 public airports have been developed or improved to meet the military requirements of the Army and Navy. Under this program local units of government, either state, county, or city, are required to own the airport property and enter into formal agreements with the Federal Government to maintain and operate the completed facilities as public airports in the interests of civil aviation. No buildings are constructed under this program. Development is limited to grading, drainage, paving of runways, and installation of field lighting. Projects must be approved by a board composed of the Secretaries of War Navy, and Commerce.

This program has been under way since the fall of 1940. Since that time approximately $400,000,000 has been appropriated for the purpose. In 1939 the C.A.A. made a nationwide survey of the national airport situation and made recommendations to the Congress on a National Airport Program. As a result of this survey and report, a tentative national airport development plan was formulated for an eventual total of approximately 4,000 public airports in the continental United States to serve civil aviation. The current airport program has generally followed the national airport plan formulated in 1939, insofar as it has been possible to do so. Certain modifications have been necessary to satisfy the military requirements of the Army and Navy.

These modifications of the original program have resulted in exceeding the national airport plan in the number of large airports built, for current requirements have generally meant that larger airports were necessary for military use than were originally contemplated for future civil use at the same locations.

Selecting a Location

To illustrate the work of the Airports Service in carrying out this airport program, it might be well to describe the steps taken in following through a single project from its inception to its completion. Planning of airports under the current program is a joint undertaking by the Army Air Forces, the Navy Bureau of Aeronautics, and the C.A.A. Since the only projects under the program are those of importance to the military services, if it is found by the Army or the Navy that their war necessities require airport facilities in a given general area, collaboration between the C.A.A. and the military branch is effected to select a specific location that will properly serve military requirements and at the same time offer the greatest use to civil aviation after the war.

When a specific location has been selected, the Airports Service field representatives get in touch with the officials of the local government concerned, either city, township, county, or state, to ascertain their willingness to acquire the necessary property and participate in the sponsorship of such a project. If this preliminary investigation discloses that local sponsorship is possible, further investigation is made by Airports Service field engineers to ascertain the availability of suitable airport sites. If such are available, the project is then recommended by the C.A.A. to the Airport Approval Board, consisting of the Secretaries of War, Navy, and Commerce, for formal action and the allocation of necessary funds.

Project Approval

When the project is approved by the Airport Approval Board and funds are allocated, a directive is issued by the Airports Service. This precisely describes the development desired by the Army or the Navy and constitutes the working orders for proceeding with the project. If the project is to be constructed under the supervision of the C.A.A., the directive is issued to the Airways Engineering Division, which acts as the construction agency on all C.A.A. construction projects. If the project is assigned to the U.S. Corps of Engineers for construction, the directive is issued to that agency. Copies of this directive are sent to the Airports Service representatives in the regional offices of the C.A.A.

Upon receipt of the directive, the regional branch of the Airports Service issues the formal proposal to the local unit of government to build the airport facilities, stipulating the Federal requirements for participation, and carries on the negotiations with local officials on the required formal agreements with the Federal Government pertaining to sponorship, maintenance, and operation of the airport after completion.

The regional branch of the Airports Service collaborates with the Airways Engineering branch in making preliminary inspections and surveys of airport sites preparatory to final selection. These two branches of the C.A.A. in the region collaborate in the final site selection.

Plans and Specifications

After selection is made, detailed plans and specifications are prepared by the construction branch of the C.A.A. within the region which issues proposals for bids. The opening of bids and the award of contracts to the lowest responsible bidders are made by the regional offices after concurrence by the Washington office of the C.A.A. During the construction period the work is under the general supervision of the regional C.A.A. office.

Upon completion of the project the airport facilities produced are inspected and accepted for the Federal Government by the regional C.A.A. engineers. The sponsoring officials of the local unit of government are then notified of the completion of the airport. Formal notification of the completion of the project is also issued to the Army and the Navy so that the plans of the military branches for the use of the completed facilities may be carried out.

At many of the airports constructed under this program additional development of a strictly military character is undertaken by the armed branch of the service to which the use of the airport has been assigned. This military development usually consists of dispersed taxiways, camouflage, cantonment and military building construction, etc.

Use Agreements

Where the Army or the Navy occupies these completed airports, formal agreements for the use of the facilities are entered into between the Army or the Navy and the local unit of government. As a general rule, these agreements consist of a lease for the exclusive or partial use of the airport facilities for not longer than the duration of the present national emergency and six months thereafter. It is anticipated that practically all

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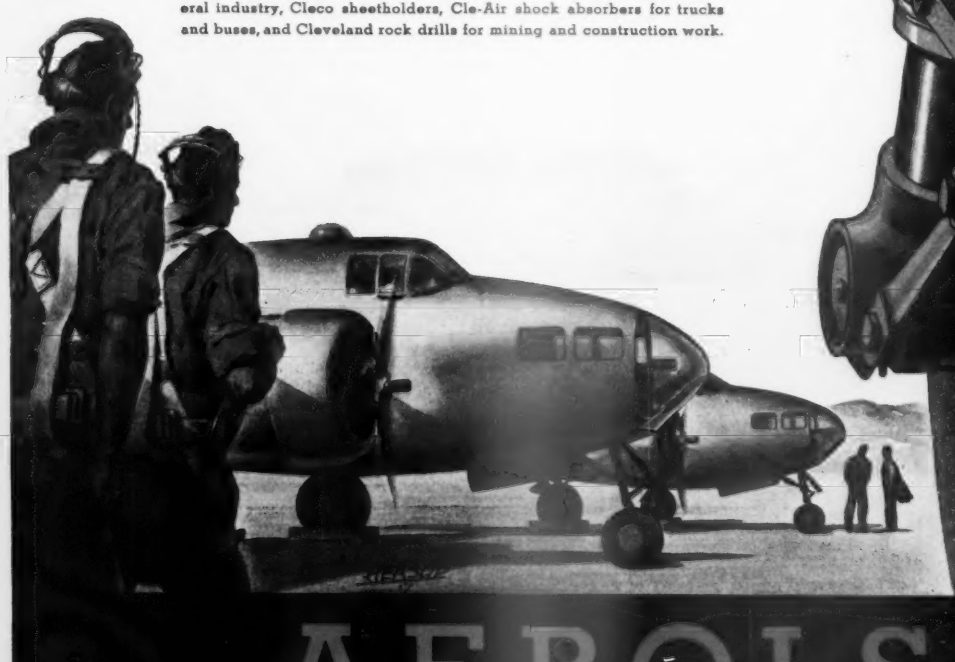

AEROLS*

*THE SHOCK ABSORBING UNITS ON AN AIRPLANE'S LANDING GEAR; THE NAME IS DERIVED FROM THE WORDS "AIR" AND "OIL"—THE FLUIDS USED TO DISSIPATE THE LANDING SHOCKS

of the airports constructed under this program will become available for the use of civil aviation after the present emergency. In this way it is possible for the Federal Government, through the C.A.A., with the collaboration of the Army and the Navy, to construct airports now needed by the Army and the Navy, but which can be utilized after the war to serve civil aviation. The large expenditures for airports needed now in the war effort thus serve a double purpose.

Other Functions of the Airports Service

In addition to the planning and supervision of the airport construction program, another important function of the Airports Service is the collection of information pertaining to all airport facilities. It is the objective of this Service to compile and keep up to date a master directory containing all available information on existing airport facilities, both military and civil, in the United States, its territories, and possessions. This job requires continuous field inspections by the Airport Service field representatives to gather information on existing airports, prepare sketches and reports, and supply the information to the many sources of inquiry both within and outside the C.A.A.

Another important function performed by the Airports Service is the research and study of airport zoning and the clearance of airport approaches. This function is under the direct supervision of the Office of the Director of Airports. Numerous requests are received from cities, counties, and states for advice and assistance in connection with airport zoning legislation and other legal matters pertaining to airport planning, establishment, development, maintenance, operation, protection, and regulation. As the number of publicly owned airports in the United States increases, the need for advice on the legal aspects of zoning, maintenance, and operation also increases.

The Airports Service is now engaged in revising the national airport plan conceived in 1939 so that it will adequately meet the requirements of expanded postwar civil aviation. This revised plan will be coordinated with local, state, and regional planning groups before final adoption, and will enable the C.A.A. to make recommendations to the Congress in the event the latter desires to continue with a postwar airport development program.

Airways Engineering

L. M. HAMMOND*

The Airways Engineering Division, in addition to its normal peacetime functions, is constructing airways and airports for the Army and the Navy. For military reasons no details of this work can be given. It can be said, however, that the Foreign Airways Extension Section is very active, and that in the United States and its possessions it is constructing an elaborate system of airports for national defense so located, for the most part, that they can be coordinated with existing airways facilities to benefit civil aviation after the war.

The Airways Engineering Division is normally entrusted with the responsibility of carrying out long-range programs for the development of the Federal Airways System. It designates routes to be improved by ground aids; surveys these routes; acquires land for each facility; constructs ground aids; provides for electric power at every airway site; leases or constructs communications lines; establishes standards for the design, arrangement, and performance of each type of facility and piece of equipment employed (except radio communications equipment).

Ground Aids

Airways ground aids have two general purposes—to provide adequate landing facilities and to provide navigational information to aircraft in flight. In the first category are intermediate landing fields and airports. The second includes light beacons and day marking for contact flight, radio-range stations and various radio "fixes" for instrument flight, superradio stations to guide intercontinental and transoceanic flights, and a vast network of land communications connecting these scattered facilities and making it possible for them to function as parts of an integrated whole. There are also such local aids to assure safe landings and take-offs as the approach light systems used in conjunction with instrument landing systems.

L. M. Hammond.

Intermediate Landing Fields

Intermediate landing fields are provided at points approximately 50 miles apart along the airways provided that no airports are available at suitable locations. These fields are defined by clear boundary lights, with green boundary lights marking the ends of the runways, and have standard beacon and course lights so that the field can be located at a distance. Weather reporting and communications stations are usually built at such fields.

Instrument Flight Aids

Aside from landing facilities, airways ground aids fall into two classifications, those for instrument flight and those for contact flight. Each must supply the pilot with two essential pieces of information—his direction and his location.

For instrument flight, direction is given by transmitting along the airway radio beams from range stations located at the terminals or between if necessary. At certain points radio markers are placed to fix position. The fan marker gives a fan pattern athwart the beam, approximately 20 miles from airports. The so-called Z-marker provides a cone pattern at the radio range where the pilot picks up the localizer beam for landing.

At the airport, instrument landing facilities include a beam indicating the position of the runway and markers placed to define certain points in the approach and the beginning of the runway.

Contact Flight Aids

For contact flight, direction is given by establishing a line of beacon lights between terminals. About five of these beacons are usually visible at one time. Direction is also given by light projectors mounted fore and aft of the beacon, fixed on the course of the airway, hence called course lights. Position is given by flashes of the course lights in a code indicating to the nearest ten miles the distance from the terminal airport to the south or west. The beacon sites are numbered to give the same information, the number being painted on the buildings of the facility. Thus, Site No. 16 is 160 miles from the westerly or southerly terminal, as the case may be.

Executive Direction

To execute the functions with which it is charged, the Division operates under the direction of its Chief, Assistant Chief, and Principal Engineer, through a Planning Unit and the Projects Engineering, Foreign Airways Extension, Construction, Public Utilities, and Standards and Specifications Sections.

* Senior Airways Engineer, Airways Engineering Division.

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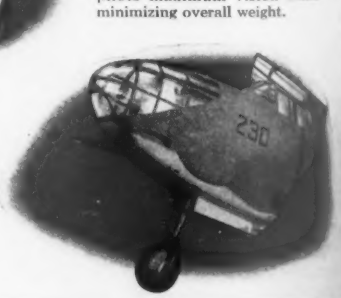

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The Office of the Chief reviews the requirements of the flying public, civil and military, and coordinates their needs in a comprehensive plan for the further development of the airways system. After recommendations are obtained from all interested aeronautical agencies, including the Army, the Navy, the States, air carriers, pilot associations, etc., these requirements are incorporated in a program prepared by the Planning Unit.

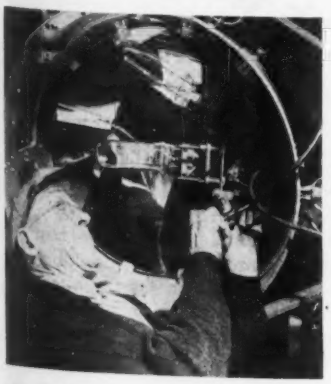
Before any project comes into being, standards of performance for each type of facility and the arrangement of the various facilities are fixed and general specifications drawn up. This is the work of the Standards and Specifications Section, which represents the Division on interdepartmental committees set up to standardize aviation ground equipment for the Army, the Navy, and the Department of Commerce.

The joint standards of the three departments assure uniformity of practice and economy in purchase.

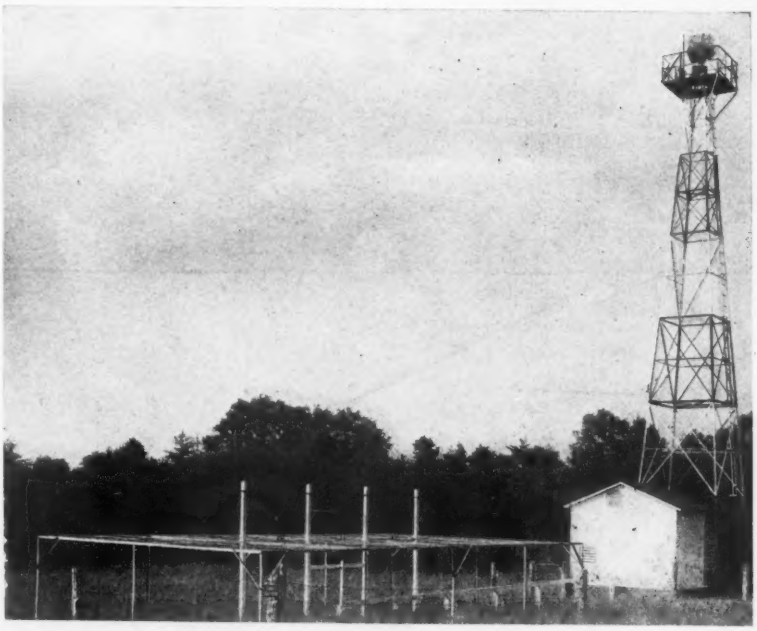
Planning a New Airway

Let us say that a project for a complete new airway has been approved. Map studies are then made by the Projects Engineering Section. All airways facilities are tentatively located. Radio-range stations to provide radio beams are projected; radio fixes in the form of fan markers and Z-type radio markers are planned for proper points on the course. Beacon lights are spotted approximately 15 miles apart and intermediate fields every 50 miles or thereabouts. Terminal airports are studied to plan light and radio approach systems. Weather-reporting and communications stations are provided for.

The skeleton of the airway having been laid out, flight surveys are made followed by ground checks. Locations of all facilities are definitely established. Land for facility sites is leased or otherwise acquired. Grades of landing areas are established, lighting plans are made for the fields, and profiles of approach systems are determined.



Maintenance check on airways beacon light. This one has a 36-in. lens.



C.A.A. fan marker along airway to inform pilot of his approach to airport or obstacle or airways intersection.

Construction

All this data then goes to the Construction Section, which decides the types of equipment required to meet local conditions. These vary depending on whether or not commercial power is available, what types of soils will be encountered, what temperatures will prevail, etc. After quantities of materials and equipment have been determined, contracts are let for purchase of equipment and construction of the facilities as a whole. Resident engineers are assigned to carry the work to completion. The flying public is notified of the facilities that have been made available.

Construction is usually not so simple as that. Before the pilot views a lighted airway, construction men often have climbed mountains, forded rivers, worked waist deep in swamps and bayous, or cleared virgin forests. Often 300-ft. towers, tractors, engines, and transmitters have been flown to sites not accessible by trail or road; 750-lb. beacons have gone to mountain tops by burro; power sheds and beacon towers have gone up on piling surrounded by cottonmouth moccasins and cypress knees, for airways ignore the physiography of the earth's surface.

Meantime, the Public Utilities Section, acting on the data supplied by Projects Engineering Section, has negotiated contracts for all commercial power required and has leased telephone, teletype, and similar lines for tying new stations in with the communication network, with the result the airway is ready for operation by the Regional office immediately upon completion of construction. This phase of the Division's work is handled by the Washington office as substantial savings in rates have been effected in this way.

Every year shows improvement in communications equipment and the development of new facilities is rapid. Today's standards are set in the light of today's best knowledge. But these are not allowed to bind tomorrow's invention.

At the outbreak of the war, great strides were being made in aviation lighting and airport design to accommodate growing air traffic. Tomorrow's standards will include not only these but other revolutionary developments born of the war.

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Formica control pulleys and cable fairleads are preferred parts because of their high strength to weight ratio, and ability to reduce cable wear.

Formica control pulleys are the result of good engineering and progressive production methods.

Other aircraft parts made of Formica are instrument panels, ignition breaker arms, radio coil forms, sub panels and tube bases, antenna insulators, propeller blades, guide blocks and vibration frequency change collars.

THE FORMICA INSULATION CO., 4636 SPRING GROVE AVE., CINCINNATI, O.

Radio and Land-Line Communications

EUGENE SIBLEY*

THE COMMUNICATIONS DIVISION supervises the planning, development, and operation of radio and land-line communication systems designed to insure the safety of aircraft operations. The two most important functions of the Division are to provide for: (1) reliable two-way communication between the ground and aircraft in flight by means of radiotelegraph or radiotelephone, receiving and transmitting such information as may be necessary for safe and efficient operations; and (2) the collection and dissemination of surface weather reports, winds aloft reports, airway weather forecasts, and aircraft movement and control messages through the medium of telephone, interphone, teletypewriter, radiotelegraph, and radiotelephone.

Eugene Sibley.

COMMUNICATION FACILITIES

The Communications Division operates 415 radio stations throughout the United States, territories, and possessions. The stations are located at proper intervals to insure satisfactory reception of signals from at least one station by an aircraft flying anywhere along the Federal Airways. At a typical airway communications station the communicators, control, and receiving equipment are housed at the airport, while the transmitters are usually located two or three miles away so that the directional radio range, in addition to providing guidance along the airways, may be utilized to maximum advantage by aircraft flying under instrument weather conditions. The glide angle for aircraft making instrument landing approaches is established with reference to the altitude at which the aircraft passes over the range station. An ultra-high-frequency radio marker definitely indicates the location of the range as the aircraft passes over the station. In approaching the airport the pilot is therefore enabled to place his aircraft in a glide angle assuring proper approach to the airport boundary, since he is aware of the exact distance from the radio range to the nearest landing area and the altitude of the aircraft as it passes over the transmitter station. At almost all radio stations voice communication with aircraft is operated simultaneously with the radio range. This permits voice communication with one pilot without interfering with another pilot who may be using the range to work out a navigation problem or effect a landing. Suitable audio filters enable the pilot to listen to range or voice signals separately or together. A breaking of the range signal into a short series of dots warns an airman with receiver set in the "range only" position that a voice communication is to be transmitted.

* Chief, Communications Division.

Transmitting Equipment

The transmitting equipment of a typical airway communication station includes two range-voice transmitters operating in the 200–400 kc. frequency band and a dual station location marker transmitter operating on 75 mc. Duplicate equipment is necessary to insure continuous service. Aircraft operations cannot tolerate interruptions of directional service resulting from equipment failures. Should the unit in operation fail, the stand-by transmitter goes into operation. A technician is available at all hours to locate and remedy difficulties in the defective unit. A gasoline-engine generator is available to take over should the commercial power supply fail.

Control Station Equipment

At the airport control station the radio equipment includes a number of receivers, a microphone, and a speech amplifier. Land lines and Strowger automatic dialing equipment enable the communicator at the airport to control operation of the equipment in the transmitter house. As it is necessary to guard low, intermediate, and high frequencies, the receivers are "all wave." Generally, they are tuned to 3,105, 3,117.5, 4,495, and 6,210 kc. and such other frequencies as are necessary to monitor local and adjacent radio ranges and permit point-to-point communications on any specified frequency.

Intercontinental Facilities

Intercontinental radio facilities are in a class by themselves. Automatic high-speed equipment is used to transmit and receive adequate meteorologic information for American and United Nations' aircraft operations around the world, and the operators maintain two-way communication service with aircraft in flight thousands of miles from the station.

There are approximately 100,000 miles of land lines in operation to provide meteorologic and aircraft movement information at the points where it is required for safety and efficiency of aircraft operations. To serve specific purposes, the land-lines operations are of necessity segregated and identified by "Schedules," as follows:

All conversations between airliners and airport control room are recorded on these dictaphones. Washington, D.C., Municipal Airport.

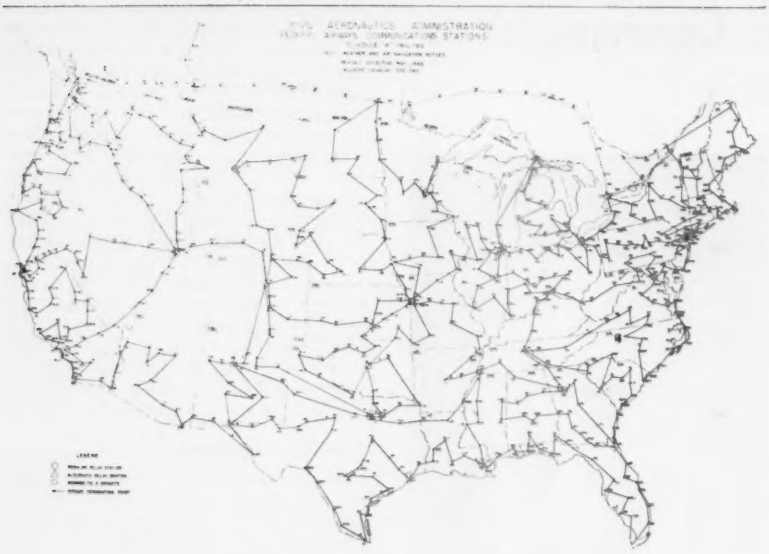


Chart of Schedule A circuit.

Schedule A.* Collection and dissemination of hourly and special surface weather reports; Notices to Airmen; coded aircraft landing and meteorologic advice; winds aloft reports and limited forecasts. (See chart for Schedule A circuit.)

Schedule B.* Aircraft movement and control information.

Schedule C.* Collection and dissemination of synoptic weather reports used in preparation of weather maps, airway and terminal forecasts, winds aloft reports.

Schedule F. Communications relative to movement and control of air traffic handled by interphone between stations along the Federal Airways.

Land-line communications operate 24 hours a day carrying information vital to the efficient and safe operation of aircraft. Land-line equipment at a communications station includes several page model teletypewriters, one for each circuit of each network on which the station is located; perforators and transmitter distributor units; switching equipment; and interphone units. Because of the great volume of traffic, all teletype circuit operations are at a speed of 60 words per min. (368 operations per min.). Scheduling of the teletype operations has been developed in the National Communication Schedule. Abbreviations, phrase contractions, symbols, and codes are extensively used. A teletype copy of a weather sequence is unintelligible to the layman, but the airman grasps the essential information at a glance. Enormous savings in circuit time result from the use of symbols and codes. Voice communications have also been streamlined. A pilot receiving traffic control instructions indicates his intention to comply by replying "WILCO," meaning "I will comply with your request."

The first interest of a pilot undertaking a flight is the weather. He is furnished with all available information in the form of surface weather reports, winds aloft reports, and airway forecasts covering the route of flight. The chart of the Schedule A circuit indicates hourly weather-reporting points. The airman checks pertinent reports before departure and obtains current information by contacting our radio stations while in flight. He must also be advised of any change in the status of radio facilities and other aids to air navigation. Our communicators must stand ready 24 hours a day to provide every service at their command. The files contain reports of hundreds of incidents where emergency assistance that definitely prevented disaster has been rendered to airmen in flight.

* Radiotelegraph point-to-point communication is utilized where land-line facilities are not available, principally in Alaska and overseas. Otherwise, teletypewriter circuits carry the traffic.

Signals

HOWARD S. STOKES*

THE SIGNALS DIVISION is responsible for the design, procurement, and installation of all radio equipment and land-line communication equipment used by the Federal Airways Service, as well as the maintenance of this equipment and other Federal aids such as intermediate landing fields and lights. These duties are divided between the Radio Engineering Section and the Airways Maintenance Section, which together with the Office of the Chief of the Division make up the Signals Division. The functions of each section closely follow those implied in the section names, except that emergency power plants and land-line communication equipment are under the Maintenance Section.

* Assistant Chief, Signals Division.

THE RADIO ENGINEERING SECTION

The facilities which the Radio Engineering Section must design, procure, and install for the Federal Airways System are extremely varied, ranging in power levels from a few watts to 20,000 watts and through a frequency range from a little over 100 kc. to well over 100 mc. A few of the items are tower- and loop-type radio ranges, station location and fan markers, UHF radio ranges, instrument landing systems, radiotelegraph and frequency-modulated transmitters, and receivers of various types, including those for diversity reception and automatic frequency control.

Since the advent of war the criterion for determining what new radio aids to air navigation should be provided has been solely military need. Much of the work has been outside the continental United States, and the work within the United States has been largely of a confidential nature that cannot be disclosed for military reasons. But as an example of the work being done, the C.A.A. has equipped 117 airport control towers at the request of the Army and Navy. Although many of the control towers had previously been in operation, the equipment did not come up to required standards. It was therefore necessary to design and purchase a full complement of equipment for almost all of the 117 towers. Ultra-high-frequency transmitters and

Howard S. Stokes.

The B.F. Goodrich Airplane of the month

CONSOLIDATED PB2Y-3

FIRST TO SPOT AND CONTACT the enemy in many a sea battle are these great patrol bombers of the U. S. Navy which operate thousands of miles out ahead of the fleet. Popularly called the Coronado, the PB2Y-3, built by Consolidated Vultee Aircraft Corporation, is the largest and most powerful mass production airplane in Navy service.

B. F. Goodrich equipment helps the Coronado perform its vital tasks with greater safety and efficiency. De-Icers, for example, crack off dangerous ice when it forms on wing and tail surfaces. And in the thick of battle, B. F. Goodrich Bullet-Sealing Fuel-Cells cut the hazard of gasoline leakage and explosion.

To the men who fly them, a nation's praise and gratitude. To the plane itself, a salute, and our nomination as "Plane of the Month."

In war or peace

B.F.Goodrich

FIRST IN RUBBER

B.F. GOODRICH RUBBER RESEARCH FOR THE *Aviation industry*

A MACHINE GUN SLUG made the gaping hole shown at right . . . a slug ripping out through a fighter plane's fuel tank. And this jagged hole—called a "flower" by technical men—would have written a flaming finis to a fighter pilot's life if it had been made just a few years ago. For then, gasoline would have poured through . . . ignited . . . !

Today it's different . . . with *our* planes at least. Our fliers cheat death time and again because *their* fuel reservoirs can take it. They can be pierced by 30's, 50's, even 20-mm. cannon shells . . . "flowers" can bloom all over their outside surfaces . . . but the bullet-sealing *inside* lining holds.

On this "inside lining" hangs a tale . . . a story of research and development that B. F. Goodrich had a large part in writing. It starts back in World War I when engineers first attempted to make fuel tanks self-sealing. Some initial success was achieved by covering the *outside* of a regular tank with rubber compounds and then covering the rubber with a protective layer of leather. But as the power of gun-fire increased, the outside covering method lost its effectiveness. Bullets passing through would force out jagged "flowers" on the exit side and rip off large sections of the covering—making self-sealing impossible.

B. F. Goodrich engineers were first to work out a practical solution to this "flowering" problem. They lined a tank instead of covering it, and in so doing made the forerunner of the bullet-sealing fuel cell most commonly used today. The schematic drawings on the opposite page show why the inside lining works where the outside covering failed.

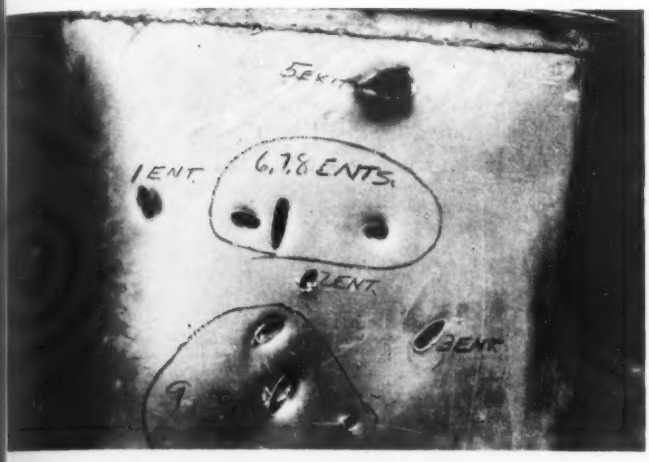
The development of the leak-proof tank insert is just one of many contributions B. F. Goodrich has made. Our engineers have done extensive work in compounding improved sealant materials. They have supplied linings and sealants that function satisfactorily in contact with aromatic fuels which tend to dissolve ordinary materials. They have devised special forms on which to build fuel tanks, which can be made up in all of the great variety of complex shapes required. They developed synthetic rubber molded connections and effective adhesives for use in fuel-cell constructions. They constructed self-sealing hose to assure safe transmission of the fuel from the fuel tank to the airplane's engines.

MAKERS OF B. F. GOODRICH TIRES AND OVER 80 RUBBER AND SYNTHETIC RUBBER PRODUCTS FOR AIRPLANES

ARMY E NAVY

Awarded seven

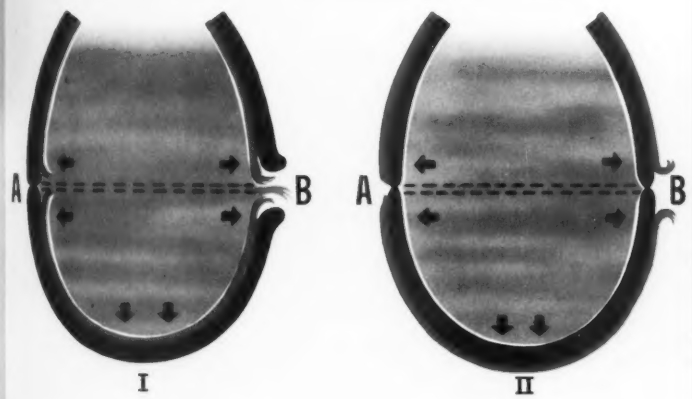
Firing tests prove fuel cells can take it
BEFORE THEY TAKE OFF !



Every combat condition is simulated in these tests...

Machine gun bullets—both 30's and 50's—incendiaries, and cannon shells are fired at test tanks filled with gasoline. Shot after shot is pumped into them from all angles to see how much they can take without leaking or exploding. Bullets are even ricochetted into the tanks to simulate deflection from a strut, propeller or some other part of the plane under fire. And these tests prove that tanks with B. F. Goodrich bullet-sealing inserts can absorb the terrific punishment necessary to bring our planes back after sky battles against overwhelming odds.

How "flowering" was licked with B. F. Goodrich bullet-sealing inserts



The two schematic cross-section drawings above show what happens when high-power bullets pierce the old-type covered tank and the modern "lined" tank. Bullet enters at (A) and exits at (B) in both; arrows indicate pressure direction. In sketch I (old type) fuel rushing out of (A) under pressure forces covering from side of tank, thus retarding self-sealing there. At (B) the terrific force causes the metal to flower, ripping a big jagged hole in the covering and stripping it off the outside. Obviously, sealing is impossible. In sketch II (modern type) the pressure exerted at (A) holds the insert tight against the metal tank and prevents separation. At (B) pressure again holds the insert tight against the tank; thus the bullet makes a cleaner hole in insert, and the flowering, being outside, is harmless.

In war or peace

B.F.Goodrich

FIRST IN RUBBER

PRIVATE GEORGIE GREMLIN SCORED 0 ON THIS

DE-ICER QUIZ

CAN YOU SCORE 100%?

Complete the ten statements by simply picking the one correct part (a, b or c) following each numbered statement. See if you can get them all.

1. De-Icers are located on . . .

a. The leading edges of wing and tail surfaces.
b. Carburetor air intakes.
c. Windshields.

2. De-Icers are made of . . .

a. Chrome-tanned elkhide.
b. Rubber and fabric.
c. Specially rolled 88-gauge aluminum alloy.

3. Each De-Icer contains . . .

a. Central tube area flanked on top and bottom by elastic stretch areas.
b. An electric heating unit encased in rubber.
c. Perforated layers of metal-reinforced leather.

4. De-Icers are operated by . . .

a. Super-heated oil at 10 lb. per sq. in. internal pressure.
b. Air.
c. Alcohol and carbon tetrachloride.

5. A De-Icer's tubes pulsate in order to . . .

a. Keep rubber from freezing.
b. Keep ice from forming.
c. Crack off ice after it forms.

6. Aluminum fairing strips are used in De-Icer installations . . .

a. To drain static electricity from De-Icer surface.
b. Because brass is not obtainable.
c. To streamline the De-Icer attachment and to act as a washer strip for the attachment screws.

7. De-Icers are attached with . . .

a. Rivnuts and screws.
b. Rivets.
c. Zoot nuts.

8. Metal end strips are used to . . .

a. Cut down wing flutter.
b. Prevent endwise creep or movement of the De-Icer.
c. To restrict tube inflation.

9. The outer surface of De-Icers is covered with a special conductive coating which . . .

a. Sets up anti-magnetic waves.
b. Bleeds off static charges that might cause punctures and explosions.
c. Cuts down air friction.

10. The rows of small vent holes in the top and bottom elastic areas are placed there to . . .

a. Trap wing-boring gremlins.
b. Cool the De-Icer system when it is not in use.
c. Facilitate movement during inflation and aid in keeping the deflated De-Icer tight against the wing.

WHAT IS YOUR SCORE?

Each correct answer counts 10. 1-a, 2-b, 3-a, 4-b, 5-c, 6-c, 7-a, 8-b, 9-b, 10-c.

This is one of a series of maintenance quizzes prepared for ground crew trainees of the U. S. Army Air Forces Technical Training Command. It is our hope that this series will help all maintenance men get maximum service, safety, and efficiency from military, commercial, and civilian aviation equipment.

B. F. GOODRICH, AERONAUTICAL DIVISION, AKRON, O.

Skyway or Highway

B.F.Goodrich

FIRST IN RUBBER

receivers are being provided, as well as intermediate-frequency transmitters and high-frequency receivers in use exclusively heretofore. Installation of the equipment of this control tower program is now well under way.

Typical Project

Specifications

Let us consider in some detail a typical project assigned to the Radio Engineering Section. Assume it to be the transmitters for the control tower project mentioned above. The various requirements for the transmitter are first considered in detail, viz., what power output should be available, what range of antenna characteristics should the transmitter accommodate, what special mechanical features must be provided to facilitate installation in the limited space available in many control towers, etc. After these questions have been decided, a specification is prepared setting forth all operating requirements, the requirements for the individual component parts, the acceptance tests for the completed transmitters, the material that must be included in the instruction books, and many other details. Although the specification is kept as concise as possible, specifications for such units frequently run over 50 pages of closely typed material.

Bids

After the specification has been written and duplicated, bidders are requested to prepare quotations for supplying the required number of units. In normal times perhaps 50 companies are asked to quote on each item purchased, and award is made to the lowest bidder, provided he is considered qualified. Wartime regulations have modified this procedure somewhat; fewer companies are requested to bid and early delivery is considered a major factor in making award.

Progress Checks

After a contract is awarded, the Radio Engineering Section's work in connection with it is far from completed. The contractor's progress must be checked frequently to see that he will complete the contract on schedule. Minor changes in the specifications must frequently be worked out as the contractor proceeds, particularly in this time of material shortages. As soon as the contractor has finished units available for test, a series of tests are run under the supervision of a C.A.A. radio engineer to determine whether the equipment is in strict compliance with specifications. These tests generally include operation at ambient temperatures much lower and much higher than ever encountered in normal operation, and frequently include operation at humidities so high that water condenses on the equipment. After the acceptance tests are passed, the equipment is shipped to the point of installation, and placed in operation by C.A.A. engineers and electricians.

The Airways Maintenance Section

The reliable operation of this equipment, now that it has been commissioned, is the responsibility of the Airways Maintenance Section. This section has developed maintenance standards and standardized procedures for ground inspection and preventative maintenance of all types of aids. Maintenance of the field and lighting facilities is performed by airways mechanicians, each of whom is assigned a group of aids, the number being dependent upon the amount and complexity of the equipment and the terrain of the airway. Maintenance of the radio and communications facilities is the duty of a force of radio technicians, each of whom is assigned a station or a group of stations, the number of stations being dependent upon the size of the station and the complexity of the equipment. Direct supervision of the work of airways mechanicians and radio technicians is accomplished through a force of maintenance inspectors and engineers attached to each C.A.A. regional office.

Servicing and Inspection

The Airways Maintenance Section prepares instructions for the servicing of the aids. The maintenance man is required to perform certain routine operations on each piece of equipment to make certain that it is in suitable condition for satisfactory operation twenty-four hours a day, unattended in most cases. The primary concern of this type of maintenance is less the problem of repair after breakdown than of reducing equipment failures and operating irregularities to an absolute minimum.

Members of the Airways Maintenance Section make field tours of inspection to determine whether prescribed standards and procedures for inspection, testing, and servicing are being followed, and to observe and be informed of the need for improvement in the maintenance of the aids. These field tours also lead to coordination of the programs within and between the several regional organizations.

The flight inspection and ground maintenance personnel of the regional organizations submit reports covering interruptions to service and failures of equipment. Copies of these reports are submitted to the Maintenance Section, where they are analyzed and measures develop to eliminate or minimize the recurrence of such irregularities. This analysis of reports leads to the preparation of specifications and the design of specialized equipment in collaboration with other sections of the Federal Airways Service, with a view to minimizing maintenance difficulties. With this in view the maintenance staff is continually contacting manufacturers to foster improvements in commercially available items of equipment and materials not built especially to airways specifications.

Communications Equipment

While its prime function concerns the maintenance of the airways system, the Maintenance Section also arranges for the procurement and installation of teletypewriter equipment for land-line communications, automatic posting boards for handling air traffic control flight data, and all kinds of engine-generator equipment. At present this staff is designing a system for the automatic diversion of messages at relay stations to their proper destinations on the teletype networks. This system will eliminate the manual handling of such messages by operators at the relay stations. The development of an automatic posting board is in its preliminary stages, and an experimental board is now in use at the Washington National Airport. A stand-by power plant that furnishes electric power automatically to an aid upon failure of the normal power supply and which automatically shuts down when the usual source is restored, has been developed by the maintenance staff and is now in wide use throughout the service.

Air Traffic Control

GLEN A. GILBERT*

Control of air traffic is of two kinds—Airport Traffic Control and Airway Traffic Control.

Airport Traffic Control

Airport Traffic Control is concerned primarily with aircraft landing, taxiing, taking off, and flight in the immediate vicinity of an airport. Control is exercised from an Airport Traffic Control Tower located in a prominent position on the edge of the airport so that it has an unobstructed view of the landing area and surrounding country.

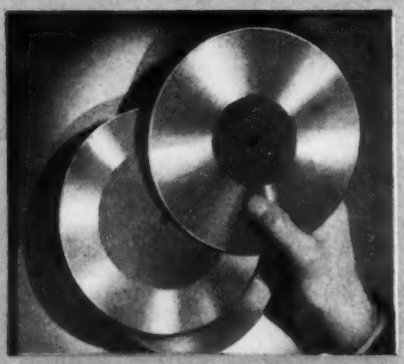
The duties of Airport Traffic Control to the flying public, both civil and military, include the issuance of appropriate instructions to aircraft for the prevention of collisions, of current information on field conditions so that pilots may be fully apprised of the suitability of the landing area, of appropriate warnings to pilots when malfunctioning of the aircraft not readily apparent to the pilot is observed by the tower, or other such necessary information as meteorologic conditions and aeronautical facilities, and the inauguration of crash or other emergency procedures when any emergency occurs on or in the vicinity of the airport.

(*Continued on page 25*)

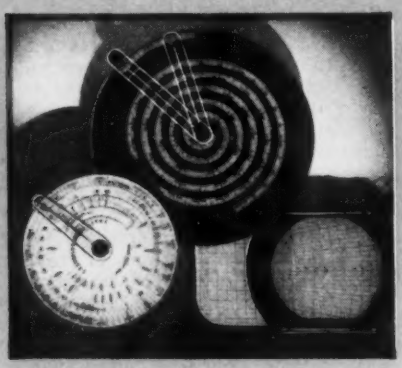
* Chief, Air Traffic Control Division.

Here's What They're Doing with

Vinylite* Plastics



LIGHT WEIGHT AND STRENGTH are important characteristics of records made from VINYLITE Rigid Sheet for sound recording and transcribing purposes. Although wafer-thin, these records are virtually unbreakable. Their exceptional dimensional stability provides high fidelity in transcribing, and prevents warping and distorting under normal changes in temperature and humidity.



DIMENSIONAL STABILITY and unfailing accuracy are assured for calculating instruments used in aircraft navigation when VINYLITE Rigid Sheets are used. One manufacturer claims calibrations can be printed to even closer tolerances on these materials than on metal sheets. Moreover, the plastic sheets require no finishing as do metal sheets.

THERE ARE three major reasons why VINYLITE Plastics are outstanding among thermoplastic materials now available to industry . . . their unique combinations of properties, their varied forms that are suited to many fabricating techniques, and the vast opportunities they present for improving the design and performance of a wide range of products.

In VINYLITE Plastics you will find materials that are basically odorless, tasteless, non-toxic, non-flammable, and highly resistant to moisture, oils, and chemicals . . . types that can be rigid or flexible . . . transparent, translucent, or opaque . . . colorful or colorless . . . as desired.

These valuable properties are obtainable for a diversity of products, since VINYLITE Plastics can be either injection or compression molded, extruded into tubes or rods, or used as the basis for coatings on cloth, metal, paper, or concrete. They can be compounded into adhesives. Rigid sheets of VINYLITE Plastics can be formed into a wide variety of flat or three-dimensional shapes.

The developments described on these pages are typical of hundreds of applications of VINYLITE Plastics that are helping to meet today's critical needs better, faster, and frequently at lower cost. A further indication of what you can gain with these materials can be obtained by writing for Booklet 12VE, "Vinylite Resins—Their Forms, Properties and Uses."

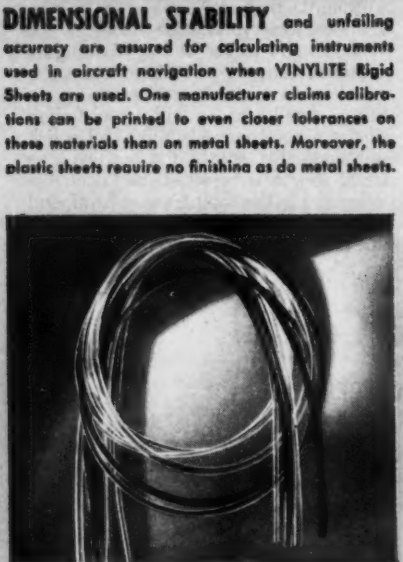
Plastics Division

CARBIDE AND CARBON CHEMICALS CORPORATION

Unit of Union Carbide and Carbon Corporation

UCC

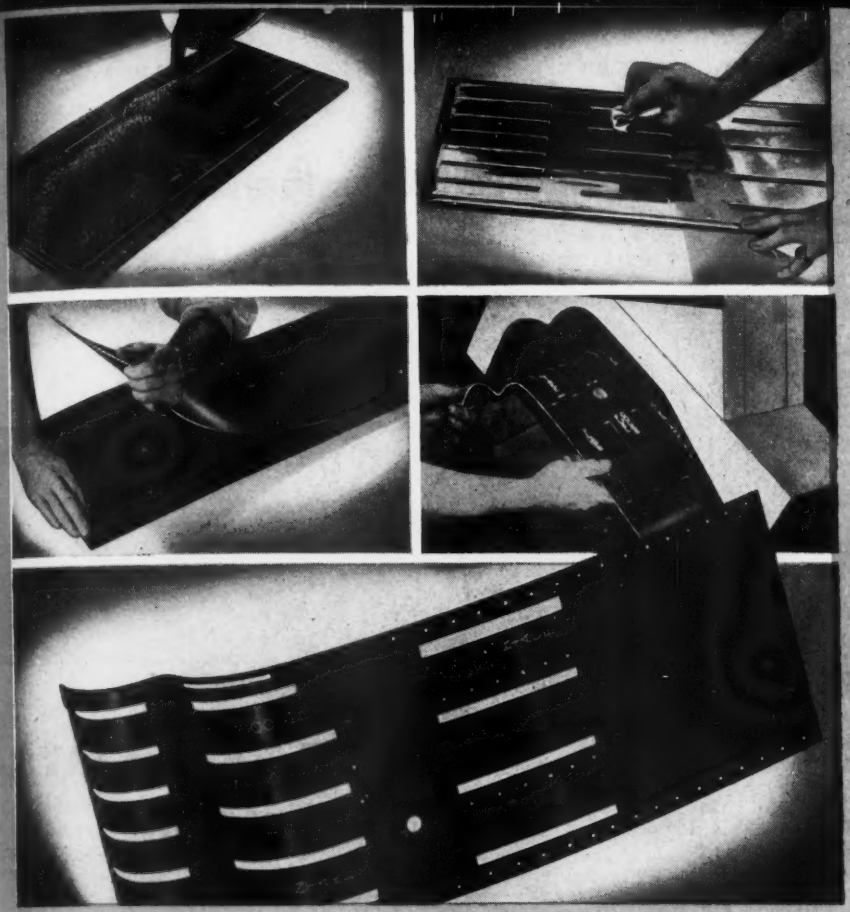
30 EAST 42ND STREET, NEW YORK, N. Y.



ACID AND ALKALI RESISTANCE of VINYLITE Elastic Plastics are employed to excellent advantage for flexible hose used in chemical service. Aging and constant exposure to light will not cause these plastics to deteriorate. Transparent extruded tubing of this type, serving as abrasion-resistant conduit for electrical wiring, simplifies inspection of vital light and power lines.

FLAME AND ABRASION RESISTANCE are outstanding qualities of wire and cable insulation made from VINYLITE Elastic Plastics. Because it is non-oxidizing, this improved insulation is more highly resistant to aging than rubber compounds formerly used. Primary insulation is extruded directly around the wire. Jacketing for outer protection is provided in the form of extruded tubing or tapes made from VINYLITE Flexible Sheeting. A wide color range facilitates color coding.

UNUSUAL CORROSION RESISTANCE for the interiors of emergency drinking water containers is provided by linings based on VINYLITE Resins. These coatings are applied by the American Can Company and are similar to those used by that company for beer cans. These impervious linings prevent interaction of can and contents. They are baked to a glasslike finish, but are highly resistant to impact shocks even at extremely cold temperatures. Because of these characteristics, the sterile water is protected against contamination during prolonged storage.



SIMPLIFIED PRODUCTION—The control panel illustrated is typical of the production economies made possible by VINYLITE Plastics. In this instance, the panel is formed, complete in every detail, by a simple molding operation. The technique employed is an adaptation of the plastic printing plate development that makes it possible to conserve substantial quantities of precious metals, and to save even more precious man-hours on the production line.

There are two fundamental steps. First, a matrix of BAKELITE Phenolic Material is made from an etched copper pattern. Second, the phenolic matrix or mold is used to form any number of duplicates from a special VINYLITE Plastic molding compound. Slots, holes, and markings, including intaglio lettering, are incorporated in the panel in this molding operation. A simple pigment "wipe" accentuates the markings and lettering. Then, the flat panel is curved to final shape under heat and pressure on a wooden mandrel. This simple technique eliminates many operations that were formerly necessary with metal plates, such as drilling, engraving, slotting, anodizing, and polishing.

(Panels Molded by Theo. Moss & Co., Inc.)

Vinylite*
TRADE MARK
ELASTIC PLASTICS • RIGID PLASTICS
RESINS FOR ADHESIVES
RESINS FOR SURFACE COATINGS
*The words "Vinylite" and "Vinylseal" are registered trademarks of Carbide and Carbon Chemicals Corporation.

WATERPROOFNESS AND TOUGHNESS for the coverings used on Navy binoculars, which formerly demanded highly cured rubber, are now provided by an embossed sheeting of VINYLITE Elastic Plastics. This plastic covering requires no curing or vulcanizing . . . withstands the corrosive action of salty spray, and prevents penetration of water vapor which would fog the lenses.

"VINYLITE" ELASTIC PLASTICS

Rubber-like materials produced in a variety of forms, ranging from soft to semi-rigid. Possess great toughness and good resistance to continuous flexing, and to severe wear and abrasion. Tensile strength greater than that of most rubber compounds. Have excellent electrical insulating properties, and do not oxidize. Can be made non-flammable and highly resistant to water, oils, and corrosive chemicals by correct choice of plasticizer.

Available in a wide range of translucent or opaque colors, or in colorless types. Supplied as sheeting, compounds, for calendering onto cloth, molding and extrusion compounds, or as powdered resins for industries that have compounding equipment, such as the rubber industry. No curing or vulcanizing is required.

"VINYLITE" RIGID PLASTICS

Produced from unplasticized vinyl resins, these various forms of plastics possess a combination of properties not found in other thermoplastic materials. Having extremely low water absorption, they remain dimensionally stable under widely varying atmospheric conditions. Outstanding in resistance to alcohols, oils, and corrosive chemicals. Have high impact and tensile strengths. Odorless, tasteless, and non-toxic. Do not support combustion.

Available in natural transparent, as well as transparent, translucent, and opaque colors. Supplied as rigid sheets, or as molding and extrusion compounds. Rigid sheet can be fabricated by forming, drawing, blowing, spinning, or swaging, and can be punched, sheared, sawed, or machined with metalworking tools. Molding compounds adaptable to both compression- and injection-molding processes.

"VINYLITE" RESINS FOR SURFACE COATINGS

When correctly formulated and applied, these resins yield finishes of unusual toughness, gloss, adhesion, and chemical resistance. Can be applied by spraying, knife-coating, or dipping to a wide variety of surfaces, such as metal, cloth, paper, and concrete. Prepared by dissolving resins in organic solvents, these finishes can be modified with different pigments, dyes, and plasticizers. The resins are generally not employed with other film-forming bases, thus coatings formulated from them exhibit the desirable features of VINYLITE Resins alone. Drying is solely by solvent evaporation. Finishes can be either air-drying or baking types.

"VINYLITE" RESINS FOR ADHESIVES

Unusual toughness, resiliency, and impact resistance are characteristic of adhesives made from these resins. They are widely used as bonding agents for such materials as cellophane, cloth, paper, cardboard, porcelain, metal, mica, stone, leather, wood, and plastic sheets and film. Available as granules for the compounding of adhesives, or as solutions sold under the trade-mark "VINYLSEAL." The latter are especially recommended for bonding impervious materials, such as metals, and the urea and phenolic plastics. Their bonding strength is comparable to that obtained with soft solder.

Damage from DINGING can be greatly reduced!
Aero Tool Swivel Flush Sets minimize dinging without sacrifice of rivet seating accuracy and smoothness. Rejections are reduced, speed of flush riveting operations greatly increased.
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Aero Tool SWIVEL FLUSH SETS Are Engineered for Green Hands

When these Sets are placed in the hands of unskilled labor better results are immediately noticeable, due to the broad angle of safety incorporated in their special design. They seat flush regardless of shank angle.

Typical Aero Tool precision design and manufacture are evident in all details of construction. Shank and Bell are of forged steel for great structural strength. Perfect fit between Ball and Socket prevents binding, assures perfect swivel action. Mirror-polished Full Crown Face eliminates excessive skin marking.

Cleaning and oiling are quickly done; the retainer collar is easily removed, the unit disassembled and re-assembled in a matter of seconds.

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BLURPING IS NOT POLITE
...even for a rivet gun. Don't "blurp" a pneumatic rivet hammer when the rivet set is not in the gun—it causes immediate damage to piston and set bushing, takes valuable time to repair. Be careful—conserve tools!

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ENGINEERED AIRCRAFT TOOLS
231 West Olive Avenue, Burbank, Calif. • Department AERO

Glen A. Gilbert.

(*Continued from page 21*)

Communication with Pilots

Communication with pilots of aircraft under a tower's jurisdiction is achieved by direct two-way radio between the tower and the pilot, or by a traffic light gun.

Control Towers

Before November 1, 1941, all airport traffic control towers were operated by the local agency having jurisdiction over the airport and in accord with locally developed procedures. These towers were, for the most part, not sufficiently staffed or equipped to handle the vast increase in military flying brought about by the national emergency and the war. The military did not wish to undertake control of civil flying. At the same time they were unwilling to accept control of military flying operations by municipal or private traffic control units. In addition, there was a need for many new airport control towers.

As a consequence, the C.A.A. was directed by the Secretaries of War and Navy to operate established airport control towers and set up new ones at specified locations as an essential contribution to the war effort. At the present time 98 towers are operated by the C.A.A., and 119 will soon be in operation by including one mobile unit that can be put into operation at any airport on short notice.

Operation of airport traffic control towers by a centralized agency permits standardization of procedures and equipment, more uniform training of personnel, and a general increase in efficiency.

Airway Traffic Control

Airway Traffic Control is solely the responsibility of the C.A.A. which has jurisdiction over all traffic operating along the 35,000-mile Federal airways system. Its purpose is to eliminate delays and hazards to aircraft operating "on instruments" under restricted visibility.

There are now 23 airway traffic control centers, each controlling about 1,500 miles of civil airways, handling more than 1,000,000 aircraft operations a month, of which more than 95 per cent are military or semimilitary in character. Each center communicates with pilots flying within its control area through various radio stations (airway communication stations, control towers, air-line radio stations, and military radio stations). The center communicates with these radio stations by interphone (leased telephone lines) or by teletype.

Pilots of aircraft flying in weather conditions enabling them to see other aircraft in time to avoid collision and to guide themselves by landmarks on the ground do not need control except when they are on and in the immediate vicinity of busy airports. Such conditions are known as "Contact Flight Rule" conditions.

Position control is necessary, however, and is provided by Air Traffic Control when visibility is such that pilots cannot see or be seen in sufficient time to avoid collision. Flight under these conditions must be accomplished under "Instrument Flight Rules." These require a pilot to obtain approval for the flight from the appropriate airway traffic control center before departure, remain in communication with ground radio stations during flight, and report his time and altitude when passing over designated radio "fixes" enroute. Data regarding each flight in the control area, as well as the estimated time of passing over "fixes," are tabulated on a control board in the center.

Handling Flight Data

As the handling of flight data and its tabulation in the center are manual operations at the present time, many verbal and manual relays of information are required. Such a system for controlling air traffic has its definite limitations. In fact, a recent study shows that by 1945, even if every possible refinement is made in the manual system, some of the busier centers will be unable to handle the volume of flight data required at that time. Therefore, an intensive study of the whole problem was made and a preliminary report has been completed and reviewed by aviation and technical experts. Their comments are being used in writing a series of reports on the subject which will be ready for distribution shortly. They will cover the principles of present air traffic control, air traffic trends, an analysis of the limitations in the present system, a program for immediate improvements, a longer-range program of improvements which must be started now if they are to be available by 1945, and a look into the future developments of air traffic control.

A typical Airway Traffic Control Center equipped with manually operated Flight Progress Boards. An elaborate communications system, both land line and radio, is necessary to record position of all planes in flight. During the fiscal year 1938, C.A.A. traffic control centers handled approximately 300,000 movements of aircraft. In 1941 the number exceeded 1,500,000 and in 1942 jumped to more than 6,000,000. In 1943 it is estimated that between 13,000,000, and 14,000,000 movements will be handled. A careful analysis of all available data indicates that the 60,000,000 mark may be reached in 1950.

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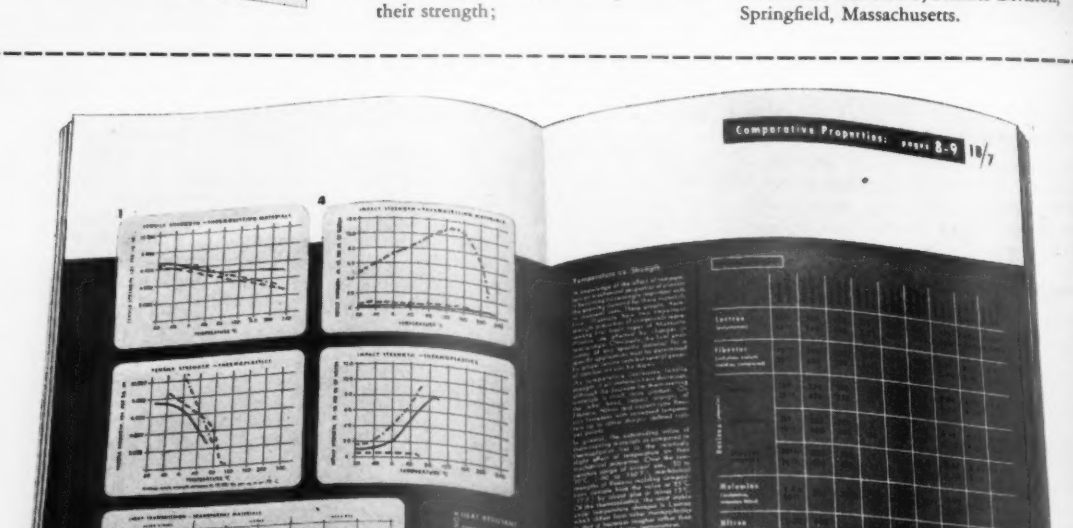

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Aircraft Engineering

A. A. VOLLMECKE*

The Aircraft Engineering Division is concerned with the type certification of aircraft, aircraft engines, propellers, and appliances. Aside from the usual secretarial and clerical staff, it is manned entirely by experienced aeronautical engineers who, almost without exception, have had extensive design and manufacturing experience in the fields to which they are assigned.

The airworthiness of an airplane depends upon the strength and reliability of the primary structure, the engine and propeller, landing gear, controls, and the like. It depends upon the proper arrangement and incorporation of emergency equipment and safety devices. To be eligible for civil use, all aircraft must meet the standards established by the Aircraft Engineering Division. Engineering data are examined and tests conducted to show that these standards are met before an airplane is approved for civil use. After a particular design has been approved and placed in operation, its service record is followed carefully. Drawings, test and stress reports, and other engineering data on all aircraft, engines, propellers, and appliances approved since the passage of the Air Commerce Act of 1926, together with records of service difficulties, accidents, and other matters, are maintained in readily usable form for reference in improving the pertinent safety standards. Here may be found engineering information on the first light planes, giant flying boats, autogiros, and on all other aircraft and aircraft components approved by the C.A.A. and its predecessors.

Functions of the Aircraft Engineering Division

The main functions of the Division are two: the evaluation of specific designs to determine their compliance with safety standards; and the development and improvement of safety standards to be incorporated in new designs. The first is done primarily in the field offices of the Division in New York, Kansas City, and Santa Monica; the latter, in the Washington office, which is primarily responsible for basic requirements, the interpretation of requirements to meet unusual cases, and the handling of administrative procedures and policies. Since such work necessitates close association with all current research and development work in the various fields of aeronautical engineering, qualified members of the Washington staff are members of various committees and subcommittees of the National Advisory Committee for Aeronautics, Army-Navy-Commerce Committee, Cooperative Research Council

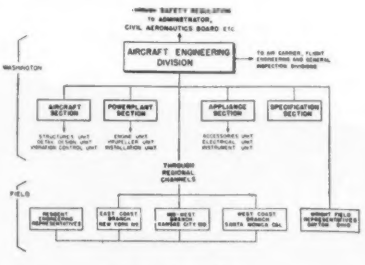
A. A. Vollmecke.

Society of Automotive Engineers, and other organizations active in the direction and evaluation of research work for the advancement of aviation.

Engineers in the field offices work with manufacturers in the examination of engineering data on new designs, in witnessing and supervision of structural, dynamic, and other test programs. Thus, manufacturers deal with a nearby office and with representatives who are accustomed to the practices of the particular company involved. Uniformity of standards for all parts of the country is assured since special cases are referred to the Washington office for interpretation and coordination with other divisions of the C.A.A. and the C.A.B.

Army and Navy Cooperation

Almost two years before Pearl Harbor, the Division took steps to integrate its activities with those of the Army and Navy because of the mutual advantages that would accrue. As a result, the military services have in many instances procured aircraft, particularly of the training and transport types, on the basis of the Civil Air Regulations.



ORGANIZATION CHART

Organization chart.

More recently, in certain types of aircraft where the contemplated purposes did not permit full compliance with the Civil Air Regulations, the services have requested compliance with at least the structural and power plant sections of the regulations or have requested special studies. Activity of this type requires close coordination between the Matériel Center, the manufacturer, and C.A.A. Such work now constitutes an appreciable part of the present activities of the Division. The military services, being eventual operators of these aircraft, maintain control over the actual detail specifications much as would an airline operator. The design of the airplanes, however, is handled by the C.A.A. as are designs intended for commercial certification and use.

In May and June, 1942, representatives of the Division materially assisted three of the principal light plane builders in the conversion of their standard production airplanes into three-place training gliders for the Army. The first of these conversions was completed in nine days. The conversions were based upon a suggestion by the Administrator made in July, 1941.

In December, 1942, at the invitation of the Army Air Forces, a special survey was made of the Wright Field organization and functions by C.A.A. representatives to determine how the above coordination could be maintained and the greatest assistance rendered. As a result of the survey, several civilian engineering representatives of this Division are on duty at Wright Field on liaison and administrative assignment. Similar close coordination is maintained with the Navy Bureau of Aeronautics.

Establishing Uniform Standards

In 1935 what is now the Aircraft Engineering Division took part in the formation of the Army-Navy-Commerce Committee for the purpose of establishing uniform standards for aircraft design information. The first publication of this group was ANC-5, "Strength of Aircraft Elements," prepared by this Division. To date, some 30,000 copies of this publication and its subsequent revised editions have been sold and distributed. The original ANC Committee was given official sanction by the Aeronautical Board and the Administrator in 1941 and now operates as the ANC Committee on Aircraft Design Criteria. Other publications have since been published or are in process of preparation.

At the suggestion of the Division the Technical Development Division of the Federal Airways has developed special vibration and flutter measuring equipment. Methods of utilizing the equipment have been devised by the vibration specialists of the Division to the point where its use has been requested by manufacturers and the military services on such diverse problems as flutter in high-performance fighter type airplanes, stress reduction in engine crankcases, and tactical glider tow force

*Chief, Aircraft Engineering Division.

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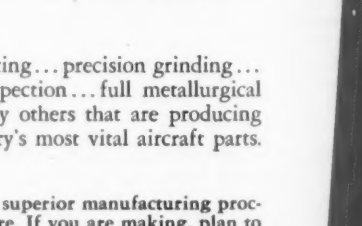
Perhaps *you* can use superior manufacturing processes, control and care. If you are making, plan to make, or need products similar to those mentioned above, our engineers will gladly consult with you concerning the application of Thompson products and processes to your specific problem. Write us today—and please include sufficient information to permit a comprehensive analysis of your requirements. Thompson Products, Inc., WEST COAST PLANT, Bell, California.



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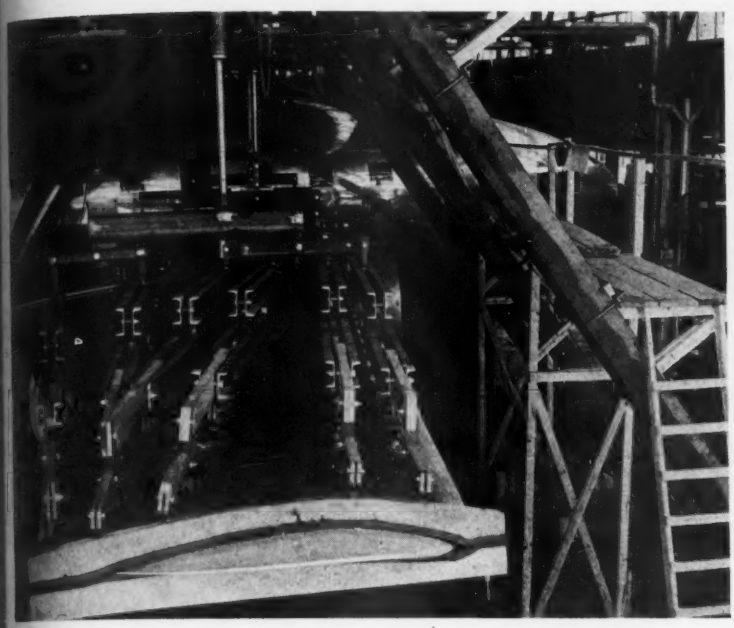

Dramatic stories of our planes "Coming in on a Wing and a Prayer" would not be possible where it not for the men of the Civil Aeronautics Administration Aircraft Engineering Division who know before a plane ever leaves the ground what stresses and strains the plane can stand. One of the exhaustive tests conducted under C.A.A. supervision determines wing strength by scientific application of pressure to simulate the worst possible flying conditions.

and stress measurements. Several reports have been issued covering simplified charts for the prediction of flutter speed and vibration modes.

The work of the Washington office in developing safety standards for aircraft is embodied in various parts of the Civil Air Regulations and manuals that cover airplane, glider, and rotary wing aircraft airworthiness; engine, propeller and appliance airworthiness; and the repair, alteration, and maintenance of aircraft. The regulations are supplemented by Civil Aeronautics Manuals which interpret specific parts of the regulations and outline acceptable methods of analysis or test procedure for showing compliance with regulations. The manuals also specify materials and detail design or repair procedure considered satisfactory for use in aircraft.

Regulations and Manuals

The regulations and manuals have been developed over a period of years on the basis of special studies and a comprehensive review of the records of many years of service experience with civil aircraft, including everything from the smallest private airplane to the largest air liners. Records of service experience are continually received on mechanical interruptions in flight, maintenance difficulties, failures and defects, etc. All important cases of this kind are given a detailed technical review with the object of correcting the cause in the particular case and also from the broader aspect of recommending revisions to the regulations with a view toward prevention of recurrence of such troubles on new designs. If a particular design exhibits chronic weaknesses, the manufacturer is requested, through the particular branch office that handled the design, to initiate remedial measures designed to overcome the trouble. These cases are generally disposed of by advising the owners, operators, inspectors, and other interested parties of the necessary changes or inspection procedures by publishing Airworthiness Maintenance Bulletins or Airworthiness Maintenance Inspection Notes.

Many products and processes that affect airworthiness are constantly being developed for use on civil aircraft. These items, by reason of their recent development or novel nature, may not be covered by existing military or commercial standards. Because of their value, however, they may soon be in extensive demand for use on civil aircraft. Examples are self-locking nuts, flexible controls, flexible hose, life-saving equipment, fabric finishes, pulleys, etc. Such items are not sufficiently important to warrant type certification as such yet it is highly desirable to advise manufacturers, operators, and C.A.A. personnel that they are considered acceptable. Hence, upon submission of engineering data and completion of necessary tests, a Product and Process Specification is issued. In general, this activity is handled by the Washington office.

Branch Office Activities

The activities of the Branch Offices of the Aircraft Engineering Division are primarily devoted to the examination of data on new aircraft designs, although a considerable proportion of their activity covers the handling of the repair and alteration of existing aircraft, weight and balance, and other engineering matters.

When an aircraft manufacturer starts the development of a new design, he usually informs the branch office by submitting certain basic engineering data and an application for a Type Certificate. At this point, he confers with the branch office concerning any special aspects of the design or any unusual features that may require special attention and interpretation of existing regulations. As the design develops, engineering reports are submitted to the branch office for review and comment. As the studies of these reports are made, the manufacturer is advised of any unsatisfactory design methods and design details which must be corrected to comply with airworthiness requirements. Frequent visits to the manufacturer's plant are usually made by the engineer assigned to the particular project to assist in maintaining close contact for the mutual benefit of both organizations. Where the project is of sufficient magnitude, it is often advisable to assign an engineer to full-time duty at the manufacturer's plant.

When the engineering data on the project, consisting of drawings, stress analysis reports, static tests, and ground operational tests, are considered satisfactory, the branch office issues an Inspection Request to cover the inspections and flight tests. The personnel of the Flight Engineering & Factory Inspection Division then carries out the necessary ground inspection and flight testing of the airplane.

If these tests and inspections indicate that the airplane is satisfactory, the Aircraft Engineering branch office recommends to the Washington office that a Type Certificate for the airplane be issued to the manufacturer. Upon a similar recommendation from the Washington office of the Flight Engineering & Factory Inspection Division with respect to the flight, operational, and inspection phases, a Type Certificate is issued; a specification describing the certificated airplane is also published. This specification lists such information as the eligible engines, propellers, required and optional equipment, operation limitations, and all other information necessary for C.A.A. inspectors in the field or at the manufacturer's plant. These specifications are also available for public distribution.

The Aircraft Section

The Aircraft Section of the Division, consisting of Structures, Detail Design and Vibration Units, is primarily concerned with the air frame. It is responsible for matters pertaining to the structural strength requirements, stress analysis and allowable strengths, airframe materials, and static testing.

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It also handles the engineering and maintenance problems associated with aircraft structure.

Part of the work consists of reviewing and correlating interpretations of existing regulations as they apply to the unconventional features of aircraft whose design is being approved by a branch office. Some of the more interesting recent problems of this nature have been the flight and landing conditions for flying wing type aircraft, rotary wing aircraft standards, design and structural test requirements for aircraft of weights approaching 500,000 lbs. Special studies are often made on such diverse subjects as allowable stresses for new materials, overload operation limitations, and the airworthiness criteria for gliders, to mention only a few.

The Power Plant Section

When the Power Plant Section lies the responsibility of developing and administering, primarily from the design standpoint, those portions of the Civil Air Regulations which pertain to the airworthiness of aircraft engines, propellers, and power plant installations. For the purpose of definition, the power plant is considered to include all elements of the aircraft which are essential for furnishing motor power, or which are necessary to assure the continued satisfactory and safe operation of the primary propulsive units. This section is composed of Engine, Propeller, and Installation Units.

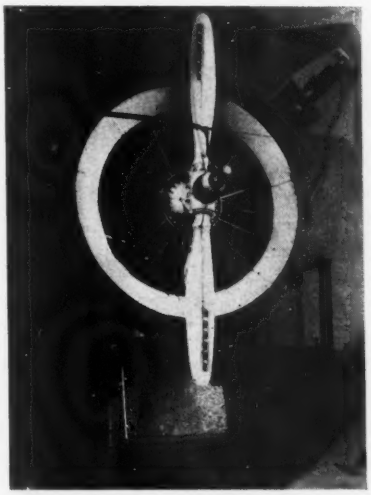
Engines and Propellers

Engines and propellers are type certificated in a manner similar to the certification of an airplane, although, of course, the demonstration of airworthiness is more directly dependent upon the results of tests than in the case of an aircraft structure, for example.

Once an airworthy engine and propeller have been selected for an airplane, there still remains the problem of providing the items necessary for the operation of these aircraft components. This, of course, includes fuel, oil, coolant if necessary, cowling, controls, intake and exhaust systems, and the like. If metal propellers are employed, it is necessary to assure that no excessive vibratory stresses exist during the operation of the particular airplane-engine-propeller combination involved. Engine and oil cooling, fuel feed and carburetor air heat rise are some of the other factors to be considered in installation.

Policy and Procedure

The Power Plant Section also deals with policy, procedure, and special problems that pertain to its work much as previously described for the Aircraft Section. Its special studies and reports deal with such matters as the use of leaded fuels to replace unleaded fuels, extension shaft drives, turbo supercharging, intercooling, propeller blade pitch stops, rotary-winged aircraft propulsion systems, and the like. This section is also responsible for the Product and Process Specifications on such items as flexible hose, flexible controls and self-sealing fuel tank liners.



A propeller that funnels out the force of a 2,000-hp. engine must, in addition to meeting strength requirements, be free of vibrations that might tear the engine away from the plane. To determine vibration characteristics of various types of propellers, the C.A.A. Aircraft Engineering Division conducts extensive tests under laboratory conditions. The various contacts along the prop blade are activated by vibrations that set up an electrical current and is registered on a galvanometer.

The Appliance Section

In the early days of the Aircraft Engineering Division and its predecessors, each engineer examined all types of data related to the airplane. However, the need for specialization soon became apparent and, just as in the case of power plant, equipment and appliance specialists were assigned to handle such data as pertained to electrical systems, hydraulic equipment, instruments, and the like. The Appliance Section issues type certificates for such equipment as floats, skis, parachutes, wheels, safety belts, flares and position lights.

A large proportion of the Product and Process Specifications also pertain to equipment handled by this group. Pneumatic deicers, generators, and leakproof batteries are a few examples of these. Other matters delegated to the Appliance Section include tire ratings, retreading, fire extinguishers and pyrotechnics.

Specifications Section

The preparation of a specification is the final step taken by the C.A.A. in the process of approving a new aircraft, engine, propeller, or appliance. That is, when all the required technical data have previously been examined and found satisfactory and an actual airplane of the model involved has been inspected, tested and found to meet the requirements of the Civil Air Regulations, a type certificate and the airplane specification are prepared by the Specifications Section and issued by the Aircraft Engineering Division.

Aircraft weight and balance matters are also handled by the Specifications Section. The proper control of weight and balance is particularly important with the capacity loads now being carried and the changes being made to carry cargo. In cases where it is desirable to increase the gross weight, the examination of balance computations for the airplane is necessary to determine whether the location of this additional load will still permit the center of gravity of the airplane to remain within safe limits under specific conditions of loading.

Another item handled by this section is the actual processing of Airworthiness Maintenance Bulletins and Airworthiness Maintenance Inspection Notes which were mentioned previously.

Section Coordination

The activities of the various sections are coordinated under the direction of the Chief of the Division and, through his office in Washington, contacts are maintained with the following other Divisions of the C.A.A. and the C.A.B.:

Flight Engineering and Factory Inspection Division on matters pertaining to operation, flight characteristics, performance and factory inspection.

Air Carrier Division on engineering phases of operation and maintenance of air-line aircraft.

General Inspection Division on the engineering phases of continued airworthiness of aircraft.

Technical Development Division on matters relating to the improvement through development of aircraft, aircraft engines, propellers and appliances.

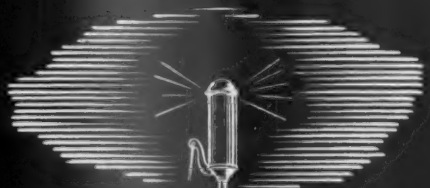
Publications and Statistics Division on the dissemination of information to owners, repair stations, mechanics, field personnel and other interested parties.

War Training Service on airworthiness matters concerning the aircraft used by that Service.

Accident Investigation Division of the Civil Aeronautics Board on accident investigations wherein structural failure, power plant or appliances are involved.

Safety Rules and Education Division of the Civil Aeronautics Board on matters pertaining to revision of existing regulations or the promulgation of new regulatory material.

Similar contacts are maintained in the field by the branch offices to supplement and correlate information and experience for the most effective and intelligent administration of the Civil Air Regulations.



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Flight Engineering and Factory Inspection

CHARLES F. DYCER*

The Flight Engineering and Factory Inspection Division, established in January, 1939, is responsible for the development of regulations governing performance and flight characteristics of all civil airplanes and provides technical supervision of those persons in the field conducting flight tests and inspections for type certification of such airplanes. It brings together within a single unit experienced test pilots and aeronautical engineers.

Functions of the Division

The routine function of the Division is to specify, in the case of each application made for certification of a new type airplane or modification of a previously approved type, the nature and extent of flight testing and inspection required; to devise a flight test program for this purpose; to conduct the necessary tests; to analyze the results and determine whether the airplane complies with Civil Air Regulations; and to conduct continuing inspection in the manufacturer's plant of airplanes manufactured in accordance with the terms of a type certificate.

Inspection

To discharge all of the duties assigned to the Division, it must undertake a great many projects not routine in their nature. The first of such projects was a complete revision of the Type Inspection Report, Form ACA 283, in an effort to provide a form which would at once guide the inspector in making a complete inspection and provide a place in which to report all of the information actually necessary to determine the degree of compliance with regulations. There was also undertaken a general revision of Chapter X of the Inspection Handbook, *Airplane Inspection for Type Certification*. This was intended to furnish our inspectors in the field with a statement of the regulations, any necessary interpretations, a recommended procedure for conducting the necessary tests, and a method to make any necessary corrections to the observed test data. This was found to be a much more difficult undertaking than had been anticipated. A preliminary draft of this handbook was issued to our field personnel for their use and comment in the light of their experience before the final revision was issued.

Controllability

Subsequently, it became necessary to study the problem of requirements governing the controllability of multiengine airplanes with one or more engines inoperative. A study of this entire subject was undertaken, and a detail proposal was made and sent to the industry for its comment. This resulted in a conference attended by representatives of the airplane manufacturing industry, the scheduled air-carrier operators, and the Air Line Pilots Association. Aggreement was finally reached upon a set of detail requirements that were made effective at that time. These have since been incorporated almost intact in the requirements for Transport Category airplanes.

Charles F. Dycer.

Requirements for Transport Aircraft

By far the largest single project undertaken by this Division has been the development of the requirements governing the Transport Category. This project began during the latter part of 1939 and grew out of general dissatisfaction with the landing speed requirement for airplanes used primarily for the scheduled transportation of passengers and goods. Concurrently with this work, the Division undertook development of photographic equipment to measure take-off and landing performance of airplanes. This was done with the cooperation of the Bell & Howell Corporation.

Reports

During the development of the Transport Category requirements, the Flight Engineering series of reports was established to make public such investigations or other information as were believed to be of general interest. To date, eight of these have been completed.

Spinning Requirements

Because attention was drawn to widely different spinning requirements specified by Army, Navy, and C.A.A., and because of obvious advantages to be gained by all concerned if these could be made uniform, the Division undertook to obtain agreement among these agencies upon a single set of spinning requirements for primary training airplanes. This project was carried forward as an Army-Navy-Commerce project under the general supervision of the Aeronautical Board. As a result of several conferences, agreement was reached and the requirements were published as ANC-14.

Other Projects

Since the war both the Army and Navy have made use of our organization to carry out special projects for them. The majority of our personnel is now so employed. Our Factory Inspectors are conducting all inspection in several airplane manufacturer's plants building airplanes for armed services. We have also conducted special tests with our photographic equipment to determine the ground performance of certain military airplanes and have carried out a number of special flight test programs for various purposes.

Recently, a study of the performance of existing carrier airplanes was made to determine whether or not the maximum weight at which these were authorized to operate could be increased with safety, for the war and the shortage of such airplanes had created a serious bottleneck. The matter was also thoroughly discussed with representatives of the industry. The results of this study indicate that increases can be safely granted. Appropriate revisions of the Civil Air Regulations have been drawn and submitted to the C.A.B. with recommendation for their adoption.

*Chief, Flight Engineering and Factory Inspection Division.

Technical Development

JOSEPH C. HROMADA†

Progress in scientific endeavors is measured not only by fundamental discoveries but equally by the application of these discoveries. Progress in the field of aeronautics is perhaps unique in its dependency upon advancements in the vast fields of related arts and sciences. The integration and practical application of such advancements to the science of aeronautics are essential functions of the C.A.A. and are carried out by the Technical Development Division.

The Technical Development Division

This Division serves as a central agency for the formulation, administration, and execution of the C.A.A.'s programs for scientific and technical

†Assistant Chief, Technical Development Division.

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Joseph C. Hromada.

developments in the field of aeronautics. This involves development, applied research, experimentation, flight and service testing, and coordination of research programs aimed at removing aviation hazards and improving the efficiency of the operation and flight of aircraft.

Military Projects

While the Division has centered its attention on civil aeronautics, a considerable amount of its work has always had a direct bearing on military aviation. Its recent activities have been primarily tuned to the successful prosecution of the war. Many development projects have been initiated at the request of the military agencies.

Nevertheless the fundamental similarity of civil and military aviation made only a few modifications necessary, and the development program remains essentially unchanged and is being carried forward with the active cooperation of the Army and the Navy.

Functions of the Division

The functions of the Division are divided among four sections dealing, respectively, with radio aids to air navigation, air navigation charts, aircraft and appliances, and airports and lighting facilities. In addition, the Division maintains an experiment station adjoining the Indianapolis Municipal Airport where most of the experimentation and flight testing is conducted. Close liaison is maintained with industrial research and manufacturing organizations, schools and universities, the National Advisory Committee for Aeronautics, and other public and private scientific agencies. Many of the developmental activities of the Division are carried on through contractors particularly qualified by reason of experience and facilities to conduct research and development in certain specialized fields.

Since its establishment the Division has successfully attacked various problems, and its contributions to aviation are reflected in numerous facilities, procedures, and regulations instituted to provide greater safety and efficiency of aircraft operation. Efforts for further betterment are progressing, and many projects have assumed the status of continuing developments upon which activity will cease only when the need for the projects has passed or a new approach offers more promising results.

Radio Developments

One of the most promising is the application of the ultra-high frequencies to radio navigational aids. Extensive experimentation and flight testing since 1934 has shown that these frequencies possess many advantages over low and intermediate frequencies because of their freedom from static, limited distance range, absence of ionospheric reflections, and large number of available frequency channels. The ultra-high frequency radio range has a well-defined distance range and a clarity of signal regardless of seasonal or climatic conditions. It exhibits a marked reduction of multiple- and bent-course effects, and is free of interference from other distant stations. In the development of the UHF radio range it has been found possible and practical to eliminate quadrant ambiguities and reversals through a combination of aural and visual signals. These inform the pilot instantly of his position relative to the station without obliging him to perform any difficult and time-consuming orientation procedure. It is further possible to superimpose one or more separate and simultaneous voice communication channels upon the same station frequency without mutual interference.

Instrument Landing

Great strides have also been made in the radio instrument landing of aircraft. As recommended by the President's special investigating committee, the C.A.A. instrument landing system was adopted for immediate service testing and pilot training. Plans for the installation of a nation-wide system of ultra-high-frequency facilities have been seriously curtailed for the duration, but considerable experimentation is being carried forward to develop a micro-wave instrument landing system. In line with this is the translation of air traffic-control communication equipment to UHF and the development of UHF aircraft direction finders.

Current Projects

Efforts are also being made to improve existing radio aids. Current projects include the development of radio-range and fan-marker monitors that automatically warn station operators and pilots of any malfunctioning of the range or fan marker. Also, improved fan and station-location markers are under development. Improvements in high-frequency automatic ground direction-finding equipment show great promise for the minimization of bearing errors.

With improved efficiency and reliability of aircraft and navigation aids, there has followed a great increase in instruments flight operations. This has created a need for charts especially designed for this use. Such charts must be clear and concise, and for maximum effectiveness must provide such necessary information to the pilot flying "on instruments" as accurately depicted radio facilities, flight levels, etc. These charts differ from the usual type in that ordinary topographic information is omitted since it is not needed in instrument flying. To supplement these charts and assist the pilot in effecting a landing through the overcast, instrument approach and airport charts have been developed. The approach chart contains all information required by a pilot in approaching a particular airport, working out his orientation, and starting the let-down procedure. The airport chart, on the reverse side of the approach chart, pictures the airport to scale and includes all necessary information on runway markings, elevations, obstructions, etc. Such charts have been devised for several hundred airports and surrounding areas where radio facilities are used for instrument let-down. Further development work on new charts and charting devices is going forward. Among such developments are special charts for seaplane use, studies to determine chart requirements for use in celestial navigation, and the construction of profile charts for the Federal Airways.

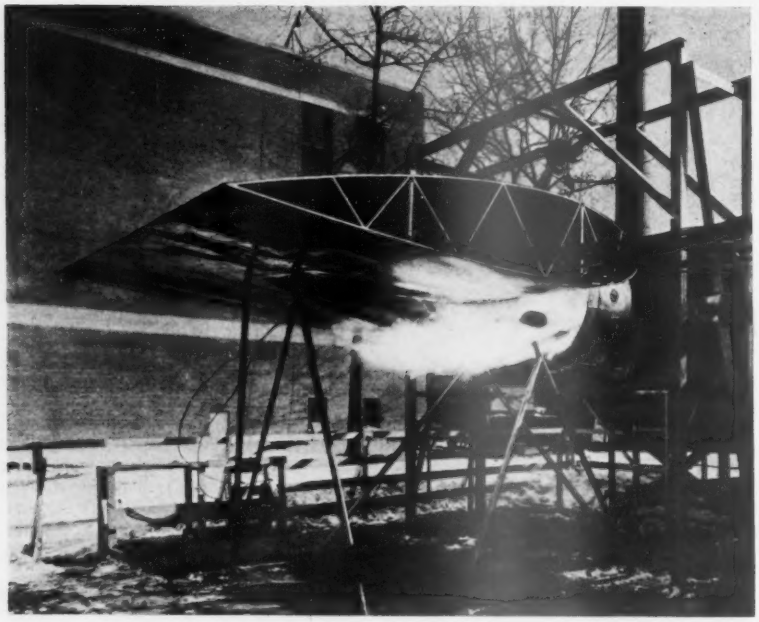
Aircraft and Appliances

In the category of aircraft and appliances, the activities of the Technical Development Division have been confined largely to eliminating potential hazards of flight and developing equipment for determining aircraft performance and structural characteristics.

Flight Problems

One project that promises to continue for some time is that of developing means to detect and extinguish powerplant fires in flight. Equipment has been developed for radial engine installations of the type common in present air-carrier aircraft, and for certain installations of the smaller, private-owner aircraft. As an indication of the extensive testing required in such a program, the mock-up of one installation was subjected to over 1,500 fires during the development of satisfactory extinguishing equipment. With the cooperation of the Army the program is continuing, and it is expected to continue as long as new types of powerplant installations and cowlings present new fire-fighting problems.

At current speeds of flight the damage resulting from collision with birds may assume serious proportions. As a consequence of several accidents and near-accidents resulting from shattered



Means for detecting and extinguishing fires in flight was a recent project of the C.A.A. Technical Development Division. This experimental setup, subjected to 1,800 fires, shows flames roaring back from the nacelle as in actual flight. Within a few seconds carbon dioxide, led to the engine through copper tubing, will extinguish the fires.

windshields, a project is under way to develop a "bird-proof" windshield. With the close cooperation with glass and plastics manufacturers windshields have been developed which are capable of withstanding the impact of a 15-lb. bird fired from a pneumatic "cannon" at speeds in excess of 200 miles an hour. A warm air anti-icing devise is incorporated in these windshields. With further development it is hoped to better present performance and arrive at a truly bird-proof and iceproof windshield.

Other Projects

Other projects in the field of aircraft and appliances include the study and solution of such problems as vibration and flutter, stall warning indication, cockpit and position lighting, and development of photographic and other means of aircraft performance testing. In the latter field equipment now under development and nearing completion includes improved photographic space-time recording devices for obtaining aircraft performance data, and control characteristics recording devices for obtaining flight and maneuvering characteristics. By these means the work of determining the airworthiness of new aircraft will be greatly facilitated.

Airport and Ground Facilities

The efforts expended in increasing the efficiency and safety of aircraft in flight would be of little avail without adequate airport and ground facilities to permit full utilization of aircraft potentialities. The Technical Development Division is constantly striving to make airports safer and more serviceable through scientific improvements in lighting, marking, paving, drainage, and other design features. The results are apparent in all modern airport lighting installations. Further development of approach lighting systems to supplement the use of radio instrument landing equipment is in progress at the C.A.A. Experimental Station. Here new types of lights are installed and tested in an approach lane, and pilots' comments and reactions are correlated. Improved marker and boundary lights, incorporating features which will assure a pilot of their identity and function when only a restricted portion of the airport boundary is visible, are being tested.

Controlling Airport Lights

Development of more effective methods for controlling airport lights so that their intensity may be adjusted to conform with visibility requirements, is also under way. Atmospheric conditions are generally described in a vague way as 1/4-mile visibility or 2-mile visibility, and merely express an observer's opinion when viewing some arbitrarily selected object. As this object and the background vary, and as observers' opinions vary, the resultant report of visibility is often difficult to interpret. An instrument for the measurement and continuous recording of visibility has been developed, and the correlation of its readings with estimates made by direct observation is being studied.

Seadrome Lighting

Another important development is that of seadrome lighting to allow trans-oceanic flying boats and other seaplanes to operate on and off water at night. This has involved development of special lights with self-contained power sources and special buoys to accommodate these lights. Closely related to this work is the development of suitable seadrome day markers. Further lighting work is concerned with the development of airway beacon lights incorporating high-intensity luminous tubes having extremely high candlepower and other desirable characteristics not obtainable in beacons of conventional type.

Soil Stabilization

In addition to lighting developments, much effort is being directed toward the development of suitable chemicals and equipment to effect soil stabilization. A successful solution of this problem would permit construction of airport runways in a much shorter time and at less expense than is required at present. All phases of the problem are under investigation, and consideration of military potentialities makes this project extremely important. An investigation to determine exact loads imposed on airport paving by aircraft during landings and take-offs is also being undertaken. This work shows considerable promise, and it is hoped that it will lead to a more effective use of runway materials and make it possible to design runways with greater load capabilities.

Human Engineering in Aviation

DEAN R. BRIMHALL*

During the discussions that led to establishing the Federal Civil Pilot Training Program, the suggestion was frequently made that such an extensive training effort would offer unusual opportunities for the study of problems related to the human side of aviation. The particular human problems of most immediate concern were those of pre-selection of pilot material and, second, the problems arising during instruction.

The need for solving such problems originates in the common-sense aim of reducing wastage of time and effort. Individuals differ in their ability to perform tasks that require formation of habits of skill. It was evident that if mesuring devices could be developed to reduce the number of those who would be found unable to become pilots.

* Director of Research.

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or those who would learn slowly and could not reach a high degree of skill, there would be a corresponding saving in time and effort.

Selection of Pilots

The National Research Council, as agent for its parent organization, the National Academy of Sciences, was asked to study the C.A.A. flight training program and to prepare methods and instruments to improve both the selection and the instruction of pilots.

Field Research

The National Research Council was further requested to cooperate with the C.A.A. in setting up an Advisory Council to help direct research in this field. This Committee was selected from leaders in the technical fields of aviation and from organizations especially devoted to aviation research. The C.A.A. then entered into a contract with the National Research Council to direct researches at various universities and other places having laboratories, skilled workers, and student pilots in training.

This was in line with the policy of the Administration to use existing civil facilities wherever possible and thus avoid duplication by the Government of research laboratories and personnel when such were already available. The Committee, although established prior to the attack of Poland, almost immediately established working relations with the Army and the Navy units interested in pilot selection and training. This relation has become closer since the onset of war, and the direction of research has been altered to meet the needs of the military forces. One of the first projects, conducted at Pensacola with the Bureau of Aeronautics of the Navy, proved to be very valuable. Other projects have since been carried out, and some are now being prosecuted at the direct request of the military authorities.

Problems of Selection

The experience of the Division of Research with the problems of selection is interesting because it was soon discovered that the elimination rate for young men and women of college age was not a serious problem so far as civil aviation is concerned. It was found, for example, that of approximately 10,000 youths of college age taking C.A.A. flight training in 1940 slightly less than 5 per cent were reported to have failed to obtain their private licenses because of inaptitude. Furthermore, the Committee has since obtained evidence of the relatively low reliability of instructors' judgments on the aptitude of their students. It is, therefore, reasonable to suppose that some of the 5 per cent eliminated for inaptitude were not necessarily unable to finish a flight training course and could have obtained a private pilot certificate within the required time. It is also possible that with improved instruction methods and an increase in the number of flight training hours, not more than 1 per cent would have been unable to obtain their private pilot certificates.

Dean R. Brimhall.

Pilot Standards

Standards for private pilot-operating a light plane are not comparable, however, with standards required for military flight. Individuals who succeeded in obtaining a private pilot certificate on a light plane might well be unable to pilot the fast and complicated airplanes used in war operations. Since almost all young men trained since 1940 by the C.A.A. have looked upon this training as a preliminary to air force service, it was all the more necessary to improve selection methods. Furthermore, for civil aviation of the future, it was obviously regarded as desirable to give vocational advice to young men and women wishing to prepare themselves as professional pilots. For these reasons the problem of selection has continued to be a subject of research by the C.A.A.

Measuring Pilot Performance

At one of the first meetings of the executive group of the National Research Council Committee for the Selection and Training of Aircraft Pilots, one of the members asked, "What criteria are available for measuring pilot performance?" In the vernacular, he wanted to know the best method of determining how well a pilot could fly. No one knew the answer. Consequently, one of the major enterprises of the Committee has been that of devising methods and instruments to measure skill in piloting civil aircraft. In attempting to solve this problem, researches on the reliability of instructors showed that ratings given students by one instructor often differed widely from ratings given that student by other instructors. The Committee therefore turned to mechanical flight-recording devices. These instruments graphically record the movements of the airplane controls, the attitude of the plane, and even the muscular behavior of the student pilot. Some of these instruments record eye behavior, muscle tension, and other physiological phenomena.

Standard flight patterns for the various training maneuvers were worked out to increase the objectivity of flight records. These recording devices are being simplified and improved so that in the future a student taking a flight examination will have his recorded and later rated as objectively as his multiple-choice written examination at the present time.

Pilot Aptitude Prediction

Researches by the committee on pilot aptitude prediction have shown that paper-and-pencil mental alertness tests have definite value. Other paper-and-pencil tests, including one that measures the general mechanical information possessed by a prospective pilot and another which is a "biographical inventory," have been developed to a point of usefulness. These tests measure the direction of a pilot's interests more objectively than uncontrolled interviews by an individual or board of examiners. Two psychomotor tests—one, to measure eye, hand, and foot coordination; the other, to measure eyes-and-hands coordination—have given especially promising results. These psychomotor tests and others are being further examined at the request of military services. Several personality tests are being developed in cooperation with able medical and psychiatric researchers at the request of the military services. Not only has the predictive value of these individual tests been examined, but the predictive value of various combinations of the tests has been determined. The present "battery" or group of psychological tests used by the Navy Air Forces is based upon the work of the C.A.A.-NRC committee.

Flight Instruction

So far as the writer knows, this research program is the first to investigate the problems of flight instruction. The usual assumption that a skillful pilot is fully competent to teach another person how to fly has controlled the practice of aviation schools throughout the world. We now know that this assumption is incorrect, and the primary work of the C.A.A. Division of Research during the coming year will be to improve the methods of flight instruction.

Researches directed toward this end have not included the examination of the content of the courses prescribed by the C.A.A. for civil flight training or those designed by the Army and Navy flight training commands. These courses should be critically examined for content, but for the present C.A.A. research accepts these courses as they are.

The accident records show, for example, that more than 50 per cent of fatalities to pilots doing nonscheduled civilian flying have their origin in the

(*Continued on page 151*)

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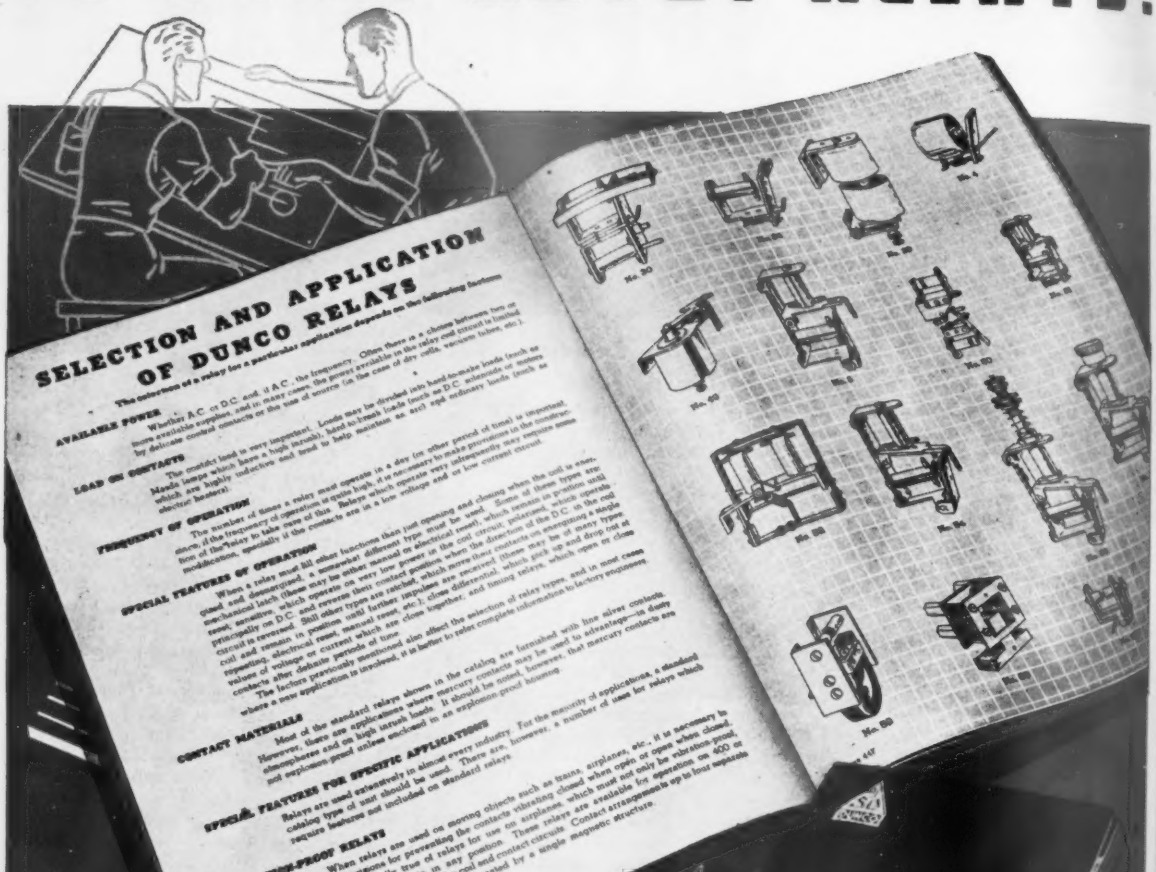

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Periodicals

Accessories

Windshield Design for High-Speed Airplanes. Mario Di Giovanni. Strict adherences to aerodynamic principles is stressed in a study of efficient design for windshields of high-performance aircraft. The practicability and advantages of certain basic shapes considered fundamentally acceptable are analyzed. These include: the V-type, conical-front type, and flat-front type windshields. The article also discusses methods of obtaining efficient vision, materials for windshields, the installation of plate glass, and means of weather protection. *Aero Digest*, July, 1943, 321–323, 325, 369, 11 illus.

Aerodynamics

On a New Theory of Free Turbulence. H. Reichardt. It is established that the distributions of momentum in motions of turbulent propagation are described with good approximation by the statistic functions of the error curve and the error integral curve. The processes of turbulent and molecular balance may therefore be compared in a certain manner one with the other, so that the rational application of the differential equation of thermal conductivity to the propagation of momentum in free turbulent flows is possible.

From this differential equation of momentum and the hydrodynamic equation of motion, it follows that the total flux of the u-momentum (brought about partly by the fluctuation motions and partly by the steady transverse motion) wandering into the transverse direction is proportional to the u-momentum gradient in this direction. As the factor of proportionality, the "transmission quantity" of the momentum appears, which is determined as a function of the mixing width by the theory itself.

The zipper idea adapted as a short cut to remove seals from ends of warplane tubes. (*See* page 136.)

By means of the formula for the transmission quantity, the known laws governing the extension of the mixing regions can be correctly represented on the basis of considerations of similitude. *The Journal of The Royal Aeronautical Society*, June, 1943, pages 167–176, 1 illus. (This translation is on file in The Paul Kollsman Library, as noted on page 119 of the AERONAUTICAL ENGINEERING REVIEW, June, 1943.)

Streamlining Dynamic Stability Computations (Part III). Dr. Max M. Munk. The third of a series of four articles on the simplification of the computation of dynamic stability deals with the organization and grouping of the quantities involved so that the computer is required to handle only a small number of terms at one time, thereby retaining full control of the proceedings. Advice is given on the choice of composite factors. A good starting point is taken as the separation of dynamics from aerodynamics, with the dynamic factors to be considered as primarily significant for the stability characteristics, while the aerodynamic quantities are to be classified with respect to the response characteristics of the airplane. Dynamic stability is defined as a motion problem; hence, velocities and accelerations are the quantities of interest. Instructions for selecting the reference velocity, the force derivatives, and the reference time, and for the simplification of the biquadratic equations are given.

The elimination of the lift coefficient from the equations and all resulting expression is stated to be a sound operation, and another factor, called the balloon coefficient, is removed, since it is held to be devoid of meaning and usefulness in connection with dynamic stability in its strict sense. The writer concludes that the quantities and coefficients in the present conventional method of making dynamic stability computations are not yet firmly established and that it is not too late for reform. He recommends the system described for future use, stating that it will eliminate the unnecessary difficulties of the older system. Further advantages of the new system are to be discussed in the fourth installment. *Aero Digest*, July, 1943, pages 249, 250, 369.

Talk About Tails. W. E. Hick. Aerodynamic principles connected with aircraft tail assemblies are discussed in easy-to-understand language. Illustrations show the blanketing of the fin by the tailplane during a spin; the components of the air reactions due to a yawing motion in the case of a dihedral twin-rudder type of tail unit; a vee tail; and a typical example of the viscous wake behind a

INDEX

Accessories 41
Aerodynamics 41
Air Cargo 42
Air Power 45
Air Transport 46
Airplane Descriptions 51
Airports 55
Armament 55
Aviation 55
Business and Finance 55
Civil Aviation 55
Control Equipment 55
Design 57
Engines 58
Inspection 58
Instrument Flying 61
Instruments 61
Jet Propulsion 61
Lubricants 62
Maintenance 62
Management 62
Materials 65
Medicine 65
Metallurgy 69
Military Aviation 69
Naval Aviation 71
Personalities 71
Personnel 71
Plants 75
Plastics and Plywood 75
Postwar Aviation 76
Production 79
Propellers 89
Radio 89
Stress Analysis 89
Testing 89
Testing Equipment 91
Tools and Equipment 91
Training 91
Warfare 92
Welding 95
Miscellaneous 95

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wing. *Aeronautics*, July, 1943, pages 38–40, 4 illus.

Prop Selection. Roy E. Marquardt and Robert De Vault. The selection of the propeller is discussed in this article, which is one of a series on power-plant performance. Among the subjects considered are the principle on which the propeller operates, the aerodynamic forces on a propeller, the equation for the power required to drive a propeller, the classic performance of a problem airplane, the selection of the best propeller from a given family of propellers, the effect of modification in propeller-blade design, multiblade and dual rotation propellers, and interference and compressibility corrections. *Western Flying*, July, 1943, pages 66, 68, 70, 76, 80, 82, 15 illus.

Air Cargo

Terminal Handling of Air Cargo. Karl O. Larson. It is emphasized that greater simplification is needed in the handling of three classes of cargo—unpackaged light pieces, unpackaged heavy units, and packaged units. Because containers used for surface-shipped goods are generally too heavy for air cargo, paper or fabric covers are desirable. It is stated new materials for this purpose are being tested.

The advantages of pallet loading with a lift truck are discussed. It is shown that the pallet may be bolted to the floor, thus eliminating the strain of lashing. Parking-space requirements for a medium-sized cargo plane are about 150 ft. square. A terminal of 10,000 sq.ft. to handle cargo from a plane of this size would require a 70-ft. wide building, one story high, and 150 ft. along one edge of the berth. These figures are based on twelve loadings per day. For each additional berth the terminal must be extended accordingly. An alternate plan is the large central warehouse for receiving, storing, and transferring. A location opposite the airport is favored, with connecting underground passage. Outlining the interior arrangement, the writer stresses the need for machine-handling to keep down the time of loading and for protection of goods.

Because of the variety of plane doors and angles in compartments, the power conveyer system of loading is often a practical solution where goods are brought to the aircraft. Weather conditions may impede outside cargo handling so that roof protection is needed. The cargo train is an active competitor for the conveyer system because it incorporates flexibility of handling for many types of goods. Fork lift trucks are most adaptable and with proper ship design, incorporating pallet loading, they offer many advantages. *S.A.E. Journal*, August, 1943, pages 285–288, 304 (Transactions).

Lightweight Packaging. Robert Welliver. This article examines the

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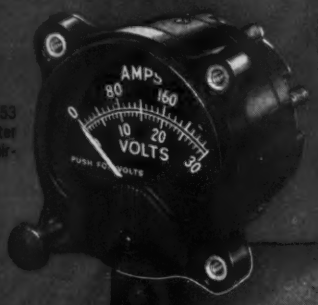

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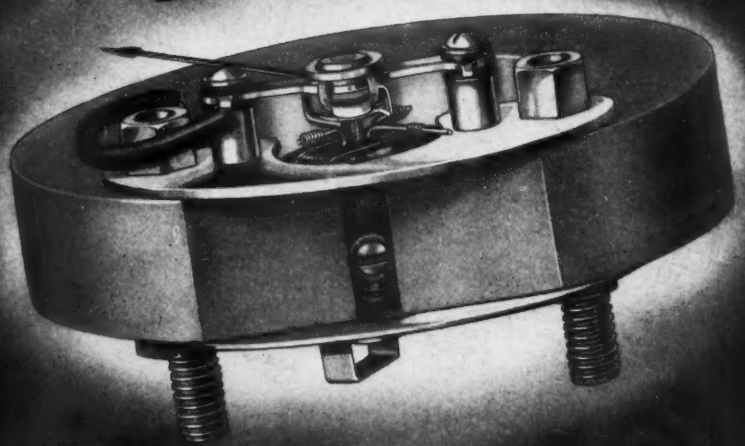

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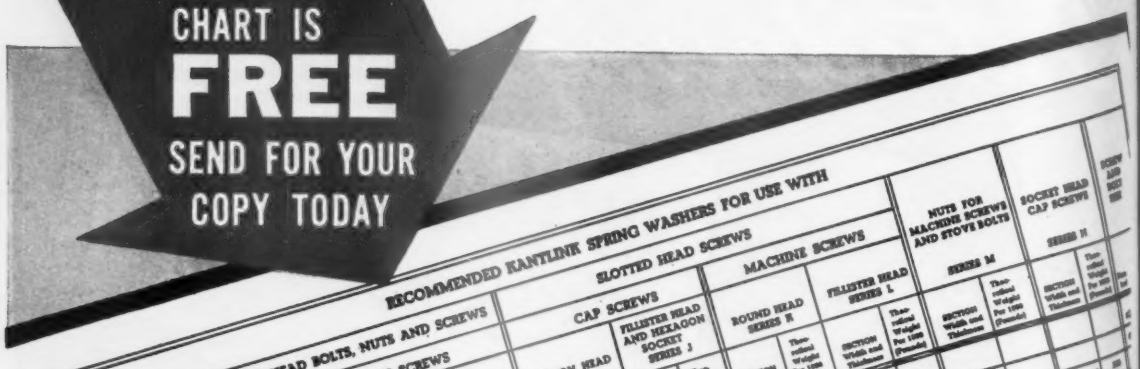
RECOMMENDED KANTLINK SPRING WASHERS FOR USE WITH
WRENCH HEAD BOLTS, NUTS AND SCREWS
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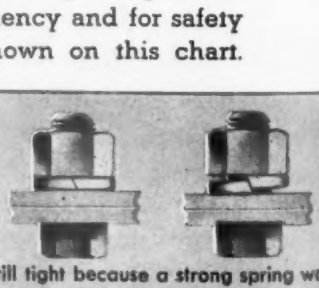
MACHINE SCREWS
NUTS FOR MACHINE SCREWS AND STOVE BOLTS
SOCKET HEAD CAP SCREWS
CAP SCREWS
IT SHOWS THE CORRECT SIZE OF SPRING WASHER TO USE WITH AMERICAN STANDARDS OF BOLTS, NUTS AND SCREWS.

These tables deserve most careful consideration. They result from many years experience and research in cooperation with the testing staffs of industrial concerns and the mechanical engineering laboratory of one of America's largest universities. Please write on your letterhead for a free copy.

A strong spring washer is essential on practically every bolted assembly. But for greatest economy, efficiency and for safety —you should use the correct size as shown on this chart.

Even if you welded the nut and bolt into one immovable mass, vibration would wear the assembly loose—unless you used a strong spring washer.



Yes it's still tight because a strong spring washer held it tight by expanding as fast and as far as inevitable wear tended to loosen the parts.

There is no substitute as economical. No fixed nut nor any short-range multi-toothed washer can possibly equal the great holding power of a long-range live spring—a big helical spring such as Kantlink. Write today to

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types of containers and packaging materials that are most advantageous for air shipments. The factor stressed as most important is that of weight. Suggestions are made with regard to materials that afford protection against the hazards of handling, moisture, abrasion, and corrosion. Among those mentioned for various kinds of cargoes are plywood, fiberboard, cardboard, flexible corrugated paper, and burlap. Materials for "stuffing" purposes are also recommended. *Flying*, August, 1943, pages 21, 22, 3 illus.

Food Air Transport to Open Vast Field. Clifford Guest. An article discussing the results of a survey that indicates that the transportation of foodstuffs by air may create a vast new specialized field for the air transport industry in the relatively near future. The survey revealed that the air lines and the aircraft manufacturers are awake to the commercial possibilities and the unique services that air transport can perform in the food industry and are moving swiftly to prepare for it. Experiments and studies being made by air lines, associations of fruit and vegetable growers and packers, and aircraft manufactures are described. *American Aviation*, July 15, 1943, pages 16, 17, 42c, 6 illus.

Aviation's Market for Air Freight. Ralph E. Oursler. The writer predicts that air cargo will not supplant surface transportation but will merely supplement it. He further states that, because of comparative costs, shipment of freight by air will be limited to specific classes of commodities. His thesis is based upon a group of statistics showing the kinds, amounts, and ton-mile costs of freight carried by the railroads in 1941 and 1942. The freight market indicated as the most feasible one for air transportation is that of present-day rail express shippers. *Flying*, August, 1943, pages 23–25, 5 illus.

Shipping Aircraft Presents New Packaging Problems. Lyle C. Ray. The work of the Aviation Packaging Corporation is surveyed. In accordance with procedures set up by the Army Air Forces for packaging airplanes preparatory to shipment overseas, this company disassembles airplanes and boxes them with the intention that a minimum of damage will occur enroute. Specified methods are followed of engine disassembly and for protection against extreme heat, cold, and corrosion of metal parts. Successive steps through which the average plane passes before being released by the Army Air Forces inspectors for final overseas shipment are related as follows: arrival at airport; inspection by Army Engineering Corps; disassembly and processing of engine; treatment of armament by Army; engineering of box by contractor; crating of fuselage wings, tail, and aileron surfaces; painting and stenciling of box indicating destination; delivery to ship side. Among the operations particularized by the article are: engine treatment, treatment of armament crating, and deck loading. *Aero Digest*, July, 1943, pages 137, 138, 141, 143, 10 illus.

The views and opinions expressed in this section are exclusively those of the writers or publications named. They are in no case to be construed as those of the Aeronautical Engineering Review or the Institute of the Aeronautical Sciences.

Air Cargo. Harry S. Pack. Part one in a series of articles on air cargo development is concerned with the basic concepts of air cargo. It includes brief notes on the history of air cargo, military activities that have advanced the transportation of cargo by air, the need for definite Government policies after the war, and the construction and design of cargo-plane types. The postwar need for airport terminals, effective marketing, and a comprehensive educational program covering shipping and packing are also considered. *Flying*, August, 1943, pages 28–31, 2 illus.

How to Ship by Air. C. P. Graddick. The head of United Air Lines' air cargo department gives some advice on the procedures for shipping freight by air. His suggestions refer to pickup and delivery service, liability and insurance, dimensions of shipments, and priorities.

Four classifications are designated for air express priorities. The first gives precedence over all other traffic on shipments whose delay would seriously and directly impair the war effort. The second covers shipments that are "absolutely necessary" to move by air for the accomplishment of a mission essential to the prosecution of the war. The third classification is for shipments whose air transportation "is vital to the war effort but not of an extremely urgent nature"; and the fourth is for shipments of sufficient importance to the war effort to justify air transportation but not so urgent as those of the other priority classifications. *Flying*, August, 1943, pages 16–18, 5 illus.

Air Commerce Guide. The first of a series of Railway Express air express rate and time schedules is presented. Chart number one is for distances from New York City to various cities of the United States and Canada. It is accompanied by a schedule of domestic air express package charges and priority data covering air express. Answers are given to the following questions: What are air express priorities; when will air express priorities be granted; which materials are entitled to air express priorities; and is there more than one class of air express priority? Other questions answered are: Who will grant air express priorities; where are those authorized to grant air express priorities located; what steps are necessary to obtain an air express priority for a shipment within the continental United States; and what data must be furnished when making application for air express priorities? Further information pertains to these questions: what indications are given that priority has been granted; will an air express priority guarantee the uninterrupted movement of the shipment; are the data applicable to shipments within the continental United States also applicable to shipments to points outside the continental United States; and what about shipments to other points outside the continental United States? *Flying*, August, 1943, pages 34–36.

Air Power

The Application of Air Power. Gen. E. P. Sorensen. The Assistant Chief of the Army Air Forces Staff Intelligence points out that there is a difference of opinion regarding the proper definitions of "air power." Before discussing the "application" of air power, the writer endeavors to provide a better definition of the term. He explains that "air power" and "air force" are not synonymous, since air force is only that part of the national air power devoted to military operations.

Subjects discussed include the internal blockade of the enemy by air force, how strategic bombing hastened the Axis loss of Africa, the blitz technique of the German air force, precision bombing, the components of an integrated air force, a pattern for invasion, and basic principles of the American air-war doctrine. *Mechanical Engineering*, August, 1943, pages 549–552.

Forcing the Sky Doors. Sedley Peck. By the process of elimination the writer supports his thesis that concentrated bombing attacks on Germany is the best method of defeating her. Taking each possible location for a second front one by one, he points out the improbabilities of success, the handicaps, and the costs of land invasion via each route. He then demonstrates the advantages of air attacks in effecting both actual damage and a dissolution of enemy morale. *Skyways*, August, 1943, pages 29, 30, 31, 57, 58, 8 illus.

Rumania's Air Force. V. L. Gruberg. A survey of Rumania's air force and aircraft industry. Noting its domination by the German Luftwaffe, the writer describes the organization of the Rumanian air force and estimates its numerical strength with regard to equipment and flying and technical personnel. He reports that the aircraft industry is composed of three firms, gives figures on the capacity of its production, and reviews

the types of fighters and bombers it builds. The standard of equipment is evaluated as mediocre and inferior in quality and performance to the aircraft of other air forces. It is claimed also that the Rumanian air squadrons have suffered such heavy losses on the Russian front that their main operations have been reduced to scouting and protection of strategic rear points. *Flight*, July 1, 1943, pages 9–11, 5 illus.

Air Keys to Invasion. Leonard Engel. In this article the writer refers to the debate on air power and criticizes some of the statements made in certain newspapers and in the book *Air Offensive Against Germany*, by Allen A. Michie. He takes exception to the contention that Germany can be defeated, without costly invasion, by continuous, day and night air assault and also to the opinion that night bombing alone can defeat Germany. He maintains that while day and night air raids are necessary, Germany cannot be defeated without the intervention of other means of assault. He states that no one form of air action or any other single type of military operation can triumph without assistance, essentially because each suffers serious limitations that are almost always ignored by the propagandists of the particular schools of warfare. *Air News*, July 15, 1943, pages 13, 14, 50, 17 illus.

Air Power over Africa. George Stromme. A detailed review of Allied air operations in the African campaign. The writer describes the tactics that were employed and gives figures on the victories gained, losses suffered, etc. Among the important points covered by the article are: the winning of bases; the obtaining of supplies; the airplanes that took an active part in the actions of both sides; the desert conditions; the men in charge of the Allied air campaigns; the utilization of fighter bombers; coordination with ground tactics; and the abolishment of the Stuka. *Western Flying*, July, 1943, pages 42, 43, 86, 88, 90.

Is German Air Power Finished? Major Alexander P. de Seversky. Discussing the possibilities of a second concentrated "all-out" aerial attack by Germany upon the British Isles, the writer depicts the advantages of such a campaign to Germany, indicates the strategy that might be used, and suggests preventive measures for the Allies to take. His arguments are based on the reasoning that Germany may have the accumulated power for an aerial offensive on Britain and that it would not hamper her defensive actions on the Mediterranean and Russian fronts. The offensive, he predicts, will be carried out in two ways: by intense aerial bombardment and by a concentration of all German submarines in an effort to ground United Nations aircraft on the British Isles through severance of supply lines as the primary strategy. Greater concentration of United Nations resources on long-range air power, intensified bombing of German targets, and the holding of positions everywhere with minimum air power while employing maximum bombing power to knock Germany out of the war are advocated as the methods for preventing a "second Battle of Britain." *The American Mercury*, August, 1943, pages 144–152.

The RAF Technique for Bombing Germany. Rex Sydney. The pattern that the Royal Air Force follows in bombing Germany is described and explained. It is stated that the British "saturation" raids are aimed mainly at Germany's power to make war rather than at her morale. A specific industrial area is destroyed by intensely concentrated bombing. As soon as industrial activity is revived, strategically timed raids on that center are resumed. Incendiary bombs are combined with high-explosive bombs to carry out this technique, and the concentration of large numbers of planes over a target area for short periods helps to congest the detection devices of the enemy. *Flying*, August, 1943, pages 21–23, 172, 173, 4 illus.

Air Transport

Post-War Transport Aircraft. Edward P. Warner. The report of the 31st Wilbur Wright Memorial Lecture, which was delivered before The Royal Aeronautical Society on May 27, 1943, in the lecture hall of the Institution of Mechanical Engineers in London, quotes the introductory remarks of Arthur Gouge, President of the Society, who occupied the chair. He gave a brief biographic sketch of Dr. Edward P. Warner, who was chosen as the lecturer representing the United States in accordance with the Society's custom of having the lectures delivered in alternate years by an Englishman and an American.

The lecturer explained that because of prevailing conditions it was necessary to depend almost exclusively upon American data for the source of his material, stating that what is true of New York is presumably true in many respects of London. He proceeded with a lengthy and detailed analysis of air transport, presenting figures and statistics on passenger and freight traffic. He summarized some general conclusions as follows:

(1) The number of points that can be given through service will vary rapidly with the minimum size of aircraft that can be efficiently and economically used.

(2) The number of air transport schedules that will be needed during the busiest part of the day will seriously overtax the capacity of a single airport by existing standards.

(3) If future development should make it feasible to operate airplanes of as little as ten-passenger capacity on reasonable economic terms, the number of schedules that would be justified and required would so increase that not only London and New York but a number of smaller cities as well would almost certainly need at least two or three independent airports for passenger transport service alone, quite apart from any provision that might be made for other classes of flying.

(4) The extent to which such duplication airports will actually be required will depend upon the extent to which air traffic control is improved through the application of wartime experience and, in particular, upon the accuracy and certainty with which pilots can be instrumentally advised of the location and distance and direction of movement of other neighboring aircraft, which they cannot see, without being exclusively dependent upon communication of such information from the ground.

The lecture also dealt with the following major topics: The economic consequences of airplane performance; size and unit cost of aircraft; wing loading and power loading; and the combined effect of wing loading and power loading. Additional topics were: further opportunities for saving costs; cost of carrying cargo; volume of cargo traffic; postwar transport speed; effect of altitude; long-range operations; regulation of airworthiness requirements and air transport operations; and regulatory standards and local transport services. Other main headings were: The future of airports; safety in air transportation; and regularity of service. Twenty-six charts and graphs accompany the lecture.

The appendix includes the notation and nomenclature and a report of the discussions that followed the lecture. These were given by Dr. Roxbee Cox, Vice-President of the Society, and Lord Brabazon of Tara, Past-President of the Society. *The Journal of The Royal Aeronautical Society*, July, 1943, pages 185–258, 27 illus.; *The Aeroplane*, June 4, 1943, pages 654–657; June 11, 1943, pages 683–685, 3 illus.; June 18, 1943, pages 712–714, 3 illus.; June 25, 1943, pages 742, 742a, 2 illus.; *Flight*, June 3, 1943, pages 581–586, 8 illus.; June 10, 1943, pages 612–617, 14 illus.; June 17, 1943, pages 635–638, 5 illus.

International Airway Operations Analyzed. E. J. Foley. Problems connected with international air-line traffic and operations are discussed, with particular reference to passenger traffic. Among the subjects considered are increased cruising speeds; the aircraft interior; passenger time consumed in complying with passport, customs and similar regulatory procedures at each end of the international line; personal service for the

HOW A NEW TYPE AIRPLANE TUBE SOLVED A BRAKE-HEAT PROBLEM

This is a cross section of the "U.S." Fabric Base Tube that solved the heat problem caused by excessive braking on the Cessna Bobcat Advanced Bomber Pilot Trainer. A reinforcing cord insert extending across the vital bead area increased 100 times the service life of the tube.

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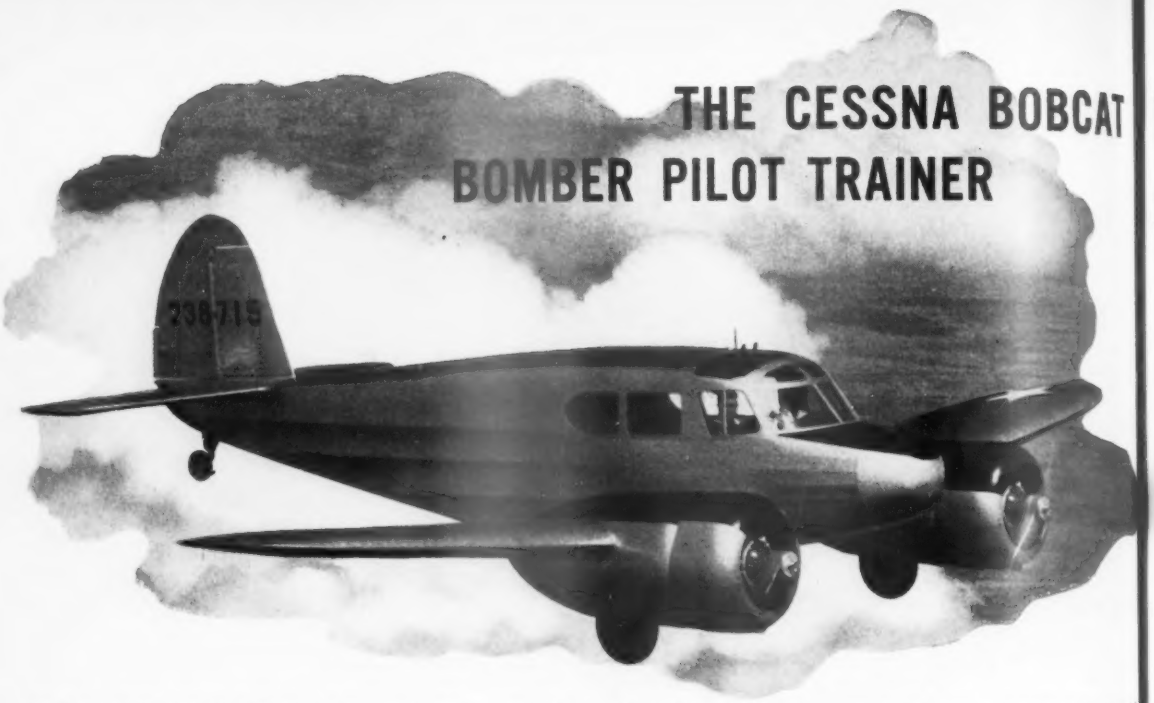


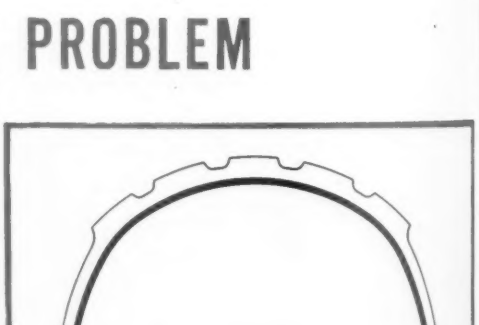
Cadets of the United States Army Air Forces fly this twin-engined advanced trainer before they take the controls of the Army's giant bombers. Like its namesake, the Cessna Bobcat is light and fast, giving the cadet his first thrill of fighting power in the air. But with this thrill, this feeling of speed, it was only natural for student pilots to use brakes excessively... and this caused overheating which made tubes fail, sometimes in less than five hours.

THIS WAS THE PROBLEM

It was natural for the cadet pilots at the controls of the Cessna Bobcat, coming in for landings at higher speeds than they had ever known before, to "tramp" on the brakes and keep them on continuously even while taxiing the plane. Temperatures as high as 750° Fahrenheit built up in no time... heats so high that no rubber tube, however good or however reinforced, could stand the gaff. Working with the brake manufacturer, Cessna engineers brought the temperature down to around 450 degrees. Performance improved, but still tube failures occurred far too frequently. That was the problem... an immediate answer had to be found.

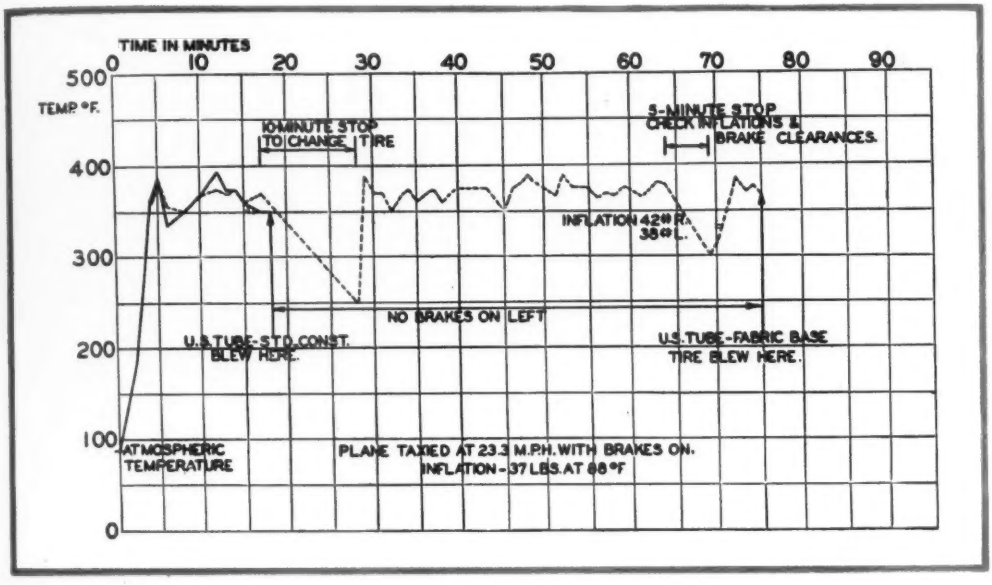
●

When an airplane tire rolls over the ground at high speeds, with as much as 35% deflection, the beads rock back and forth on the rim, stretching out the tube just above the toe of the bead. When the tube is cool, it remains elastic and snaps back into place without damage. But at high temperatures, the tube thins out, is stretched farther and farther and finally some of the weakened, thinned-out rubber is tucked in between the bead and the rim. The result is a "pinch"... and quick tube failure.



Listen to the New York Philharmonic Symphony broadcast over Columbia network every Sunday afternoon 3:00 to 4:30 P. M. Eastern War Time.

THIS IS THE ANSWER WORKED OUT BY CESSNA AND "U. S." FIELD AIRPLANE TIRE ENGINEERS



Jim Berry, one of the "U.S." Field Airplane Tire Engineers working with Cessna on the problem had a trick up his sleeve. Taking a leaf from his experience on bus lines where high brake-drum heats are frequently encountered, he suggested to Cessna that the "U.S." Fabric Base Tube might be the answer to this problem just as it had been the answer in the case of certain city-type buses.

Special tubes of this type were built and tested under the most severe conditions. In the test shown in this chart, a U. S. Royal Rayon Airplane Tire with a conventional construction U. S. Royal Tube was mounted on the left landing wheel of the Bobcat. On the right wheel a U. S. Royal Airplane Tire and Fabric Base Tube were mounted.

In five minutes of taxiing with brakes on, the temperature, checked by a pyrometer, was over 450°... and in 18 minutes the conventional tube blew out. They took ten minutes out to change the tire. Then, on with the test. The tire equipped with Fabric Base tube went on and on for 75 minutes with brakes applied until the casing failed because of carcass fatigue. The problem was solved—the proof of the pudding is that U. S. Royal Tires equipped with Fabric Base Tubes have been in service for 450 to 500 hours without failure...when before, tubes often failed in less than five hours.

Read what Cessna engineers said about the test: "It is concluded from this test that the Fabric Base Tube will outlast any casing under these conditions." If you are faced with a tube problem, the "U.S." Fabric Base Tube may be your answer. The services of a "U.S." Field Airplane Tire Engineer are available to test it on your aircraft.

The way this problem was met and solved is not an isolated case. It is an example of the practical engineering service that "U.S." offers to the aircraft industry through its Field Airplane Tire Engineers.

J. G. Berry, "U.S." Field Airplane Tire Engineer, and A. E. Kangas, Cessna's Service Manager, inspect an installation of U. S. Royal Airplane Tires and Fabric Base Tubes. New Cessna Bobcats are now 100% "U.S." equipped on main landing gear.

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How "U. S." Field Airplane Tire Engineers Can Help You With Your Tire Problems

"U.S." Field Airplane Tire Engineers are located at or near the principal aircraft manufacturing centers. Each of them is a graduate engineer. Each has had a generous background of high speed, heavy service tire and tube operation and now applies all of this training specifically to airplane tire and tube problems. Through this service, coordinated and assisted by a staff of technicians at the factory, such achievements as the rayon carcass airplane tire, Conductive Rubber, the Ice Grip tire, the Fabric Base Tube have all been developed. Each product advance has answered a specific problem in airplane tire engineering. As new problems are met, these "U.S." men are ready to help you find their solution.

This new book of Airplane Tire Facts is yours for the asking!

Just off the press, this 62-page book contains the latest technical data and engineering information on landing wheel, tail wheel and beaching gear tires and tubes. A series of 33 Load-Deflection Curves shows at a glance percentage deflection and deflection in inches at varying loads and pressures. A request on your firm letterhead will bring your copy without charge.

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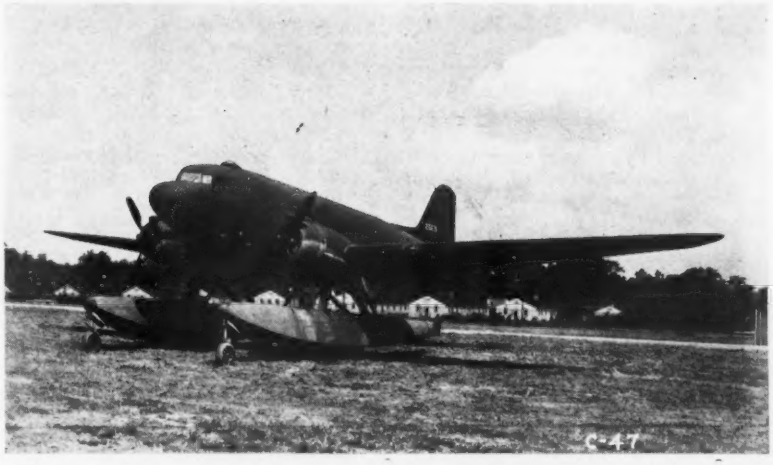
passenger, including the food problem; the air-lines' responsibility toward the passenger when delays arise at a foreign station; and the traffic personnel problem. Operating problems are discussed under sections covering the crew, its organization, accommodations, and operating technique. *American Aviation*, August 1, 1943, pages 56, 64, 1 illus.

Wings over the River. George E. Bounds. A historical outline of Chicago and Southern Airlines. The writer traces the rapid development of this air line from its organization in 1933 to the present. The activities of the company in its present form are classified and described. *National Aeronautics*, July, 1943, pages 16, 17, 36, 38, 40, 42, 28 illus.

Cruise Control for Flying Efficiency. R. Dixon Speas, Jere T. Farrah, and Sanford Hinton. First of a series of articles on the control of power conditions in cruising flight. This installment is concerned with power requirements in air-line operation and how they may be controlled to obtain for each flight the desired results of increased safety, greater airplane utility, fuel conservation, and maximum pay load. Types of cruising that may be achieved by power control are divided into eight main classifications: (1) maximum endurance; (2) maximum range; (3) constant instrument air speed; (4) constant power; (5) maximum speed; (6) rapid fuel consumption; (7) maximum pay-load miles per hour; (8) maximum pay-load miles per hour of operating costs. The purpose of each type of cruising and the means of accomplishing it are discussed in detail. Items of flight technique, designated as most important to efficient operation are also considered under the following topical headings: (1) lateral attitude of airplane; (2) air turbulence; (3) maintenance of constant altitude; (4) extraneous drag; (5) changes in power conditions; and (6) use of engine superchargers. *Aviation*, July, 1943, pages 202–205, 333, 334, 337, 338, 6 illus.

Commandos for Commerce. Dean Smith. Part 1 of a two-part article discussing the adaptation of present military air cargo carriers for postwar commercial utility. This installment describes the Curtiss-Wright Commando cargo transport, Model 20-C, now in operation, and shows how it will be immediately available for air commerce after the war.

The performance of the Commando is examined in detail under the specific headings of: (1) the time required, (2) the load carried, and (3) the cost of operation. Some of the factors involved in a determination of the traffic that may be available to a transport airplane of the model 20-C type, both domestically and internationally, are also observed. Charts and tables illustrate the operating range of the Commando (flight time vs. operating range and pay load vs. range); its cruising speed; the direct flying cost per plane-mile and per ton-mile; the rates of New York—Chicago operations compared with prewar air express and railway mail; and percentage of total traffic at various periods of the day on a New York–Chicago run and a Washington–New York run. *Flying*, August, 1943, pages 7–11, 7 illus.



The Douglas C-47 equipped with amphibious floats which are over 41 ft. long, 5 ft. high, and have a maximum width of 5 ft. The landing gear retracts into the floats during flight.

Fundamentals of Air Transport. G. E. Woods Humphery. An article on British air transport and its future. Questions considered include whether or not there should be a separate ministry for air transport, whether there should be one chosen operator or more, and the use of subsidies versus a healthy private industry. Freedom of the air is also discussed. *Aeronautics*, July, 1943, pages 28–30.

Northwest Deliveries. David Baker. A summary of the instructions for combating cold-weather problems which are given by the Ferry Command and the A.T.C. to pilots operating along the Alaskan routes. Preparations and briefing cover topography, radio facilities, following the highway or the flight leader, weather reports, avigation, and such items as proper clothing, shoes, and sleeping bags. Several anecdotes of what has happened to pilots forced down in the northlands illustrate the necessity for these preparations. The article also includes some notes on the operation of the Alaskan route by the A.T.C. and the Ferry Group and the civilian groups who have contributed to the success of the job. *Aviation*. July, 1943, pages 225, 227, 374, 377, 378, 4 illus.

Canada's Flying Post Has Silver Anniversary. Frank H. Ellis. The 25th anniversary of air mail in Canada occasions a review of several pioneer Canadian air-mail flights. Beginning with the first flight from Toronto to Montreal in June, 1918, the brief history also covers the initial flight from Calgary to Edmonton, the one from Seattle to Vancouver, B.C., the first mail delivery by air from Newfoundland to the British Isles, and the first mail to be flown over the Canadian Rockies. *Canadian Aviation*, July, 1943, pages 41–44, 98, 102, 12 illus.

Edmonton—The Gateway to Asia. Gordon McCallum. The importance of the city of Edmonton in Alberta, Canada, as a center for American and Canadian air transport routes is portrayed. Postwar aerial transportation is considered, as well as present war transport operations. The significance of Alaska and northwestern Canada as a hub for world air routes and as an advantageous air entrance to Asia is pointed out in noting the aerial importance of Edmonton.

The writer also briefly describes the Edmonton Airport, its intense war activity, and the development of airline operations in the Canadian northlands. He relates the experiences of Grant McConachie, now western general manager of Canadian Pacific Airlines, to illustrate the growth of northland aviation. *Commercial Aviation*, June, 1943, pages 46, 48, 50, 53, 4 illus.

Airplane Descriptions

The New Halifax. Recent modifications that have been made in the Handley Page Halifax bomber. The current version is designated Halifax II Series IA. The changes that have taken place during recent months are traced and the latest model is described. It is shown that the changes were made as a result of experience, looking toward the improvement of the plane from an aerodynamic standpoint as well as the betterment of the armament and engines.

The writer states that the outstanding feature of the new series is the new dorsal turret, which is mounted snugly on top of the fuselage and has four guns. Improvements mentioned are the wider field of fire, easier maintenance and replacement of the turret, while drag is negligible compared with

the two-gun turret on earlier models. Other alterations are improvements in the bomb compartments, sealed engine nacelles, improved cowling, semi-retractable tail wheel, a different finish on the underside of the fuselage, and changes in the nose and its armament. It is stated that a gain of 10 per cent has been obtained in both maximum and cruising speeds and that the cruising ceiling has been appreciably improved. Better performance in other respects is reported. *The Aeroplane*, June 18, 1943, page 692, 1 illus.

Negative Stagger. Winfield Foster. The writer analyzes the design of the Beechcraft D-17-R plane for civilian pilots. It is indicated that the distinguishing feature of this plane is that the lower wing is placed substantially forward of the upper wing—the reversal of traditional design. It is explained that largely because of this negative stagger the plane, when approaching a stall, will automatically recover. *Air News*, July 15, 1943, pages 30, 50, 1 illus.

Details of the Mosquito IV. Additional structural features of the de Havilland Mosquito IV are reproduced in a series of drawings. Some of these explain the method of joining the wings to the fuselage and the form of construction used in the after end of the fuselage. Others show the tail control mechanism and the device for retracting the tail wheel. Drawings of the rudder control and the cooling apparatus are also included. *The Aeroplane*, July 2, 1943, pages 14, 15, 12 illus.

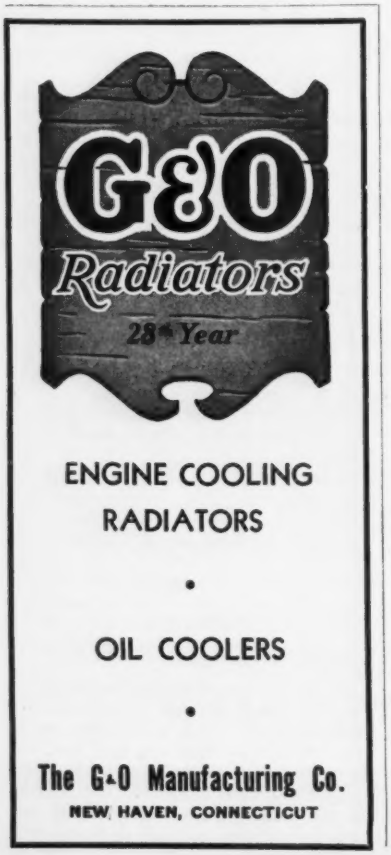
New Details of Germany's Latest. Brief comments are made on the engines, armament, and equipment of recent German aircraft. Planes included are the Messerschmitt Me 210 A-1; Messerschmitt Me 109G-2; Henschel Hs 129 ground attack; and Junkers Ju 87D1. *Aircraft*, June, 1943, pages 14, 15, 4 illus.

First Analysis of the Thunderbolt. Peter Masefield. A report on the design, performance, and construction characteristics of the Republic P-47. Specifications of the Thunderbolt are listed. In a summary of the fighting qualities of this fighter, it is stated that: (1) at 30,000 ft. it is one of the fastest airplanes in squadron service today; (2) with a great diving speed by virtue of its weight, the Thunderbolt can outdive the FW 190; (3) its great weight also reduces its rate of climb in comparison with lighter fighters; (4) in maneuver its rate of roll is excellent and the size, speed, and high-wing loading of nearly 46 lbs. per sq.ft. with full load makes its turning circle rather wide; (5) the turbosupercharger combined with 18-cylinder engine gives the Thunderbolt its highest performance at about 30,000 ft.; (6) the wide fuselage, the position of wing and cockpit, and the large radial cowling tend to restrict the pilot's view in certain directions; (7) the eight machine guns have the hitting power of 2,368 muzzle horsepower. *Flying*, August, 1943, pages 47, 48, 188, 190, 2 illus.

Convair Patrol Flying Boat for Anti-Submarine Duty. A description is given of the Consolidated Vultee Model 31 patrol flying boat, which has been developed for anti-submarine duty. This aircraft has a cruising speed of 160 m.p.h. and will be produced for the Navy. It is a high-wing monoplane with two engines, twin tail, and retractable wing floats, and is of aluminum-alloy construction with fabric-covered ailerons, elevators, and rudders. Power is supplied by two Wright model R-3350, 2,000-hp. engines.

Both the combat version and the transport versions for peacetime flying are described and illustrated. The transport versions has two flying decks. In the combat version the interior deck separation is eliminated and the space is occupied by fighting equipment. *Automotive and Aviation Industries*, August 1, 1943, pages 26, 27, 140, 3 illus.

Two High-Powered Fighters Compared. The Hawker Typhoon and the Republic Thunderbolt are compared in text and by numerous paired pictures. The differences between these two heavy, high-powered fighter planes are emphasized, as well as the points in which there is found to be some resemblance. Comparisons are based upon wing shape and other details of the fuselage, speed, engines,



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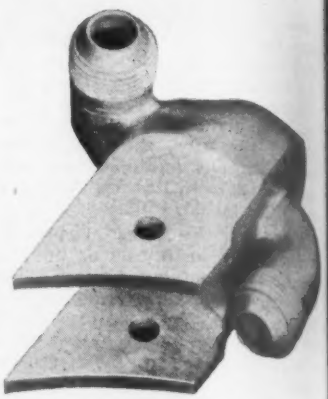

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and armament. Specifications are given in parallel columns. The history of each airplane is traced briefly, and the article concludes with remarks about the relative merits of liquid-cooled and air-cooled engines. *Aeronautics*, July, 1943, pages 50–53, 18 illus.

Airports

Long-Range Airport Problem Needs Study. E. J. Foley. The subject of long-range airports and terminal facilities, as distinguished from present "units," is discussed. Aspects of the separation of terminal facilities are analyzed. The writer suggests that the concept of a long-range airport be built around a "family" of airplanes. Although not intending to imply that an airport should be limited to one specific model of airplane, he visualizes comparative standardization for a reasonable time to facilitate the design of the airport. Details are given on the equipment and operation of the suggested airport. *American Aviation*, July 15, 1943, pages 64, 65, 1 illus.

Armament

The Assessment of Aircraft Armament. Peter G. Masefield. In a review of the advances that have taken place in the armament of military aircraft, the writer stresses a comparison of the qualities of various types of armament relative to one another for the work each is required to perform. It is suggested that former standards based on weight of fire in pounds of projectile per minute be supplemented by standards based on (1) rate of fire in rounds per minute or per second; (2) mass of each projectile in pounds; (3) muzzle velocity of each projectile. What the writer defines as "muzzle horsepower" is offered as a new criterion for the measurement of the relative efficiency of aircraft armament. It is shown how various guns and combinations of guns in different types of aircraft compare on the basis of this suggested measurement, and results of the discussion are tabulated. A formula is developed for the calculation of muzzle horsepower. The article contains a plea for specialized armament for special purposes and examines present types of aircraft in the light of the ideal visualized. The discussion is divided into the particular types of combat airplane, exemplified by specific references to British, American, and German airplanes and their armament. *The Aeroplane*, June 11, 1943, pages 672a–677, 43 illus.; "Fire Power," *Aircraft*, June, 1943, pages 10–13, 7 illus.

Flying Gun Carriers. Arthur Grahame. The development of aircraft armament is traced and possible future trends in aircraft gun design are considered. A comparison is drawn between the fire power of a one-place fighter plane of 1918 and that of a modern fighter. Photographs show the historic development of air arms. *Popular Science*, September, 1943, pages 82–86, 212, 213, 21 illus.

The irregularity of receipt of publications from abroad necessitates the review of articles in issues several months late. This is done to provide readers with information regarding foreign technical progress as soon as the issues are available in the United States.

Avigation

Are You Going Where You're Looking? Leighton Collins. Difficulties caused by the drift of an airplane in cross-country flight are reviewed and suggestions are offered on ways to overcome the troubles. A "sighting" system for navigating an airplane is outlined. This system is based upon the use of a compass and the selection of a series of "targets" to determine drift. Pointing out the main weaknesses in the conventional system of contact navigation, the writer indicates also the specific conditions under which the suggested system will work most advantageously. *Air Facts*, August, 1943, pages 52–58, 3 illus.

Business and Finance

Slump . . . Or Surge. H. L. Federman. The writer rejects the pessimistic point of view that accepts a tremendous postwar decline in the aircraft industry's markets as being "inevitable" by demonstrating the factors that can combat such a condition. He reports a survey, issued by the Department of Commerce, in which a high level of industrial productivity is indicated for the postwar period, and (based on the assumption that the war and the immediate postwar conversion will be over by that time) an aircraft production total of $442,000,000 is given for 1946. The trend indicated by Lockheed Aircraft's purchase of the controlling interest in a West Coast automobile finance firm is analyzed, and the possibilities of the aircraft manufacturers entering nonaviation markets after the war are shown. Among the potential products listed for diversified manufacture are automobiles, household goods, and electrical appliances. The factor of air transportation growth is given as a reason why aircraft equities should not be following the market decline prevailing at the time of writing.

Three tables supplement the writer's analysis. One is a hypothetic projection of expenditures for commodity groups that are likely markets for the aircraft industry. Another lists Barron's comparative stock averages for aircraft, air transport, and 50 representative stocks during May and June, 1943. The third illustrates the trend of leading aircraft equities for the years 1938–1943 and shows that the current prices are the lowest of that period. *Aviation*, July, 1943, pages 113, 378–381.

Renegotiation in Operation. Lt. Col. C. D. Dyson. An analysis of the renegotiation statute and how it works. The writer explains the purpose of the statute, telling how it helps check excessive war profits and inflation. He also answers the question of why renegotiation is based on profit before, rather than after, taxes. Notes are included on the Vinson-Trammell Act, which preceded the renegotiation statute in profit-limiting regulation. *Skyways*, August, 1943, pages 34, 35, 76.

Mid Year Checkup on Aviation Finance. R. L. Raymond Hoadley. An analysis of the aircraft industry's profits for 1942 and a consideration of the factors that will affect the earnings for 1943. Renegotiation claims, voluntary retroactive and current price reductions, and taxes are discussed as the factors that will offset the sales increase of 1942 and bring the profits for that year down to the 1941 prewar level. Renegotiation and taxes are expected to cut profits on 1943 business also, but the writer notes the possibility of favorable legislation regarding postwar reconversion reserves. A table gives the profit, dividend, and sales records of 16 aircraft manufacturing companies for the years 1941 and 1942. *Aviation*, July, 1943, pages 114, 343.

Civil Aviation

Flood Flyers. Maurice Roddy. An account of how aviation was employed to prevent the spread of damage during a major flood in the Mississippi Valley. Periodic patrols, maintained by pilots of the Illinois State Militia, permitted a constant and accurate check of flood conditions. The airmen were charged also with the mission of searching for isolated families, livestock, breaks in levees, road washouts, and threatened areas. It is stated that these activities have created a future pattern for flood control operations. *Flying*, August, 1943, pages 49, 50, 192, 3 illus.

Control Equipment

Fluid Flow Through Restrictions. L. S. Greenland. A study of the laws governing the motion of fluids, with particular reference to fluids used in the control of aircraft engines and equipment. In general, problems confronting designers of aircraft fluid systems are mainly concerned with changes of pressure and rates of flow.

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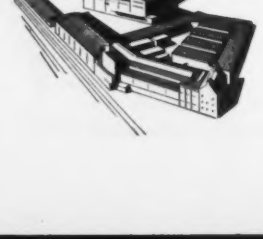

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The writer examines the laws that govern these changes for fluids in both the liquid and gaseous states and arranges in concise form the means by which problems of this kind can be readily solved. The different fluids used, though few in number, are quite distinctive in their physical properties. These include air, gasoline, oil, and coolant liquids. *Aircraft Engineering*, June, 1943, pages 160–164, 9 illus.

Design

The Significance of Weight Control. John E. Ayers, Sr. The intent of this discussion is to outline briefly the purpose and significance of weight and balance control for the benefit of readers who are being introduced to the subject and to emphasize the importance of weight control and its far-reaching influences. The chief purpose and proper execution of weight control are defined, and its benefits are grouped in the order of their importance under the following headings: (a) improved safety; (b) greater load-carrying capacity; (c) reduced manufacturing costs; (d) lower operating costs; (e) smaller investment costs. A detailed discussion of each of these five factors is given. The writer summarizes the subject with the statement that weight control is the art of combining functional complexity with structural simplicity. *Aero Digest*, July, 1943, pages 287, 290, 291, 1 illus.

Air Frame Weight. Edward Fife. It is stated that aeronautical weight engineers need a convenient, universal method for determining air-frame weight. The writer explains the reason why a uniform method of determining air-frame weight is important.

Theoretically, the term air frame should consist only of the structure of the airplane, but for practical purposes the definition would not necessarily hold. Air-frame weight is used primarily as a basis for determining the cost per pound expended by the manufacturer in the fabrication of the aircraft, not including any consideration for purchased or customer-furnished parts. A general definition is given of the term air-frame weight which is believed to be specific enough to prevent misinterpretation or confusion. *Weight Engineering*, Spring, 1943, pages 13, 14.

My Plane of the Future. Lloyd H. Sloan. The writer submits his ideas for the design of a fixed wing "family airplane" after the war. He anticipates a twin-engined, four-place airplane having a gross weight below 3,000 lbs. and cruising comfortably at 150 m.p.h. He specifies that the plane should possess good single-engined performance, a 500-mile range, two-way radio for traffic and range work, and a complete panel of flight instruments. The desirable selling price for such a model is placed at around $2,500. *Canadian Aviation*, July, 1943, page 60.

Protective Engineering for Delicate Military Equipment. Paul C. Roche. An article describing the principles developed for mounting delicate instruments and other vital equipment in airplanes, tanks, and ships. Protective mountings are classified fundamentally into two groups: (1) those used to isolate, from the supporting structure and surroundings, disturbances originating within the mounted equipment; and (2) those used to support delicate equipment, protecting it from disturbances existing in the supporting structure. The article is largely confined to the latter category. Sections of the article discuss the steady-state vibration and shock in military equipment; basis for selecting antishock mountings; how the Navy approaches shock problems; "isolation" and "absorption" methods of reducing vibrations; "snubbing" as a means for controlling vibrations; and practical considerations for the vibration engineer. *Mechanical Engineering*, August, 1943, pages 581–587, 10 illus.

The Post-War Weight Control Engineer. A. E. Vesco. It is explained that in designing for quantity aircraft production some sacrifice has to be made in the performance that is affected by weight. The loss in useful load has not penalized the operation of military aircraft because it has been offset by overloading, particularly in cargo planes. Therefore, weight control, though necessary, has not been paramount in the development of military planes. When nations can devote themselves to humane endeavors, the aircraft manufacturers will be competing with one another to a higher degree than ever before. Accelerated design, time, and quantity production will become secondary to quality of performance, and performance affected by weight will become the deciding factor when an operator purchases a transport plane. The need for ultimate weight control will then be paramount. Ultimate weight control involves achieving the lightest design possible for a given function consistent with good design practice. The writer discusses how this can best be accomplished. Necessary qualifications of the engineers who are to conduct weight control work are outlined. *Weight Engineering*, Spring, 1943, pages 20, 21.

Design for Service and Maintenance. J. E. Frazer, M. M. Cone, and C. G. Schulze. A detailed discussion of the need for considering the serviceability and maintenance of an airplane when it is being designed. The development of adequate service and maintenance design is given parity with the development of high speed and performance, because it is demonstrated that, unless the aircraft can spend a maximum number of hours in the air and a minimum of hours on the ground for service and maintenance, the loss in revenue is as great as or greater than that which results from low speed or poor performance. Analyzing the costs of design changes after production release of the drawings, the writer urges that the question of serviceability receive attention in the preliminary design stages—with simplicity and accessibility as two fundamental requirements. He also points out advantages to production through service design, contending that if a unit can be simply and quickly repaired and maintained in the field it can be quickly and easily produced and installed.

Observation of the postwar aspect of the problem indicates a trend toward built-in serviceability and unit installation. It is stated that the first types of components which should be designed as complete units ready for installation and operation in the airplane are those that consume the majority of service time, such as hydraulic units, electrical units, power plants, landing gear, etc. Basic requirements for developing and expanding service design, the organization of a service design group, and the training of the men in it are also outlined. *Aero Digest*, July, 1943, pages 297–299, 301–303, 305, 319, 11 illus.

Designing for Production. Part IV. James E. Thompson. Welded structures are dealt with in the fourth of a series of articles on the designing of aircraft parts. It is explained that welded structures are usually associated with fuselage, empennage, or wing components but can be applied as substitute or alternative designs for "hard-to-get" forgings and castings. Determination of the fuselage form to be used for a welded steel-tube fuselage structure is discussed. Some designers favor the all-steel tube design, while others prefer the composite type of fuselage. Factors involving the basic geometry of the tube structure, which must not be neglected if production design is to be achieved, are referred to. Following the consideration of these factors, the design of the side frames is discussed. Other sections cover steel tube fuselage layout, fitting design, balanced joints, and machine allowance. *Western Flying*, July, 1943, pages 54, 56, 58, 60, 7 illus.

The Weight Engineer and Stainless Steel Construction. Donald M. Sullivan. Some of the interesting problems for the weight engineer offered by the stainless-steel airplane are reviewed, and the distinction between weight estimation and calculation and determination of the actual weight are explained. Other features of stainless-steel construction are outlined.

The conclusion is reached that many of the problems encountered in stainless-steel design are similar to those

encountered in design utilizing any other basic material. The problem of weight calculation in steel has been solved to a satisfactory degree, but the problem of weight estimation requires further study. The possibilities of high-speed aircraft of the future, taking advantage of higher allowable stresses and the many other features of stainless steel, may pioneer a new era in structural design efficiency. *Weight Engineering*, Spring, 1943, pages 38, 39.

The Dive Bomber. "Helldiver." First part of a detailed article which examines the special attributes of the dive-bombing aircraft of the various Allied and Axis powers outlines the applications of dive bombing in modern warfare and discusses the trends and variations in dive-bomber design. In this installment the theory of dive bombing is explained, while both the advantages and limitations of this type of airplane are also considered. Claiming that most of the criticism directed against dive bombers is based upon judgment of planes in the "Stuka" class, the writer concedes that this type may be said to be outmoded but demonstrates the merits of more modern dive bombers. He describes the development of fighter bombers, twin-engined dive bombers, and the adaptation of four-engined heavy bombers. Among the planes that come up for discussion are the Brewster Bermuda, Hurricane IID, Me 210, Ju 88, He 177, and others. *Flight*, June 10, 1943, pages 601–605, 12 illus.

Experimental Determination of the Moment of Inertia of Control Surfaces. R. T. Shaftel. The moment of inertia of control surfaces can be rather accurately calculated from the known individual weights and moment arms. However, it is often desirable, and occasionally required to determine the moment of inertia experimentally. This involves the manipulation of the actual surface in some fashion or other in order to arrive at the moment of inertia.

A method for the experimental determination of the moment of inertia of control surfaces which has been used successfully is described. *Weight Engineering*, Spring, 1943, pages 49–50, 4 illus.

Lofting Problems of Streamline Bodies. (Part 15). Carter M. Hartley and Roy A. Liming. The fifteenth part of this lengthy article on the design of streamline bodies is devoted to the mathematical and graphic techniques considered especially effective in the fairing and development of a radiator air scoop. Conditions governing the lofting of such a structure are outlined and the procedure is established. The calculation of basic scoop contours is shown and demonstrated by mathematical examples. The application of similar methods to the determination of the external lower centerline of the air scoop and the internal upper and lower centerlines is explained.

These methods are shown to facilitate the work of the designer in making changes to accommodate alterations resulting from flight tests, enabling him to concentrate upon his specialty in structural development. It is stated that the saving in time obtained through the procedures given is multiplied many times in the various successive stages of designing the completed unit. *Aero Digest*, July, 1943, pages 309–311, 357, 359, 5 illus.

Structural Weight Allotments and Control. C. R. Englebry. The writer shows that it is during the preliminary design stage of the airplane that the most promising results from good weight control can be realized, since it is then that materials, type of structure, and production features are being arbitrated with weight, cost, and serviceability.

To achieve efficient designs with the minimum of wasted design time, weight control must be on a technically sound basis. The first step is to prepare a breakdown of the parts as they will be designed and to prepare a fair allotment for each major item. To explain the principles of this first step for the weight engineer in the design stages of the airplane, the wing flange material is used as an example. *Weight Engineering*, Spring, 1943, pages 51, 52, 2 illus.

Engines

Measurement of High Temperatures in High-Velocity Gas Streams. W. J. King. Errors experienced with conventional methods of measuring temperatures of gas streams having velocities around 500 ft. per sec. and temperatures of the order of 1,600°F. are referred to. Such conditions of gas velocity and temperature occur, for example, in the exhaust pipe of an airplane engine. The paper presents the results of an investigation of this problem. Tests were conducted on the thermocouple, which is called the most satisfactory temperature-measuring device at present available, to develop a shield and mounting that would achieve maximum accuracy and minimum size and weight for airplane application. The results indicate that something better than the ordinary thermocouple mountings is required for even a fair degree of accuracy with either the high velocities or temperatures considered. A few tentative devices are suggested to serve until further studies have been made and more adequate solutions provided. *Transactions of the A.S.M.E.*, July, 1943, pages 421–431, 13 illus.

Engine Crankshaft Frequency Curves. J. Morris and W. J. Evans. This paper deals with the torsional vibration of a multithrow crankshaft, coupled with the flexural vibration of the propeller. It is explained that so far no entirely satisfactory method has been evolved for the numerical solution of equations for obtaining the frequency curves of the crankshaft-propeller system. In this paper the "escalator" method, evolved by J. Morris and J. W. Head, is applied to the solution of these frequency equations. *Aircraft Engineering*, June, 1943, pages 156–159, 164, 4 illus.

Carburetion for the Aircraft Engine. F. J. Wiegand. Emphasis is placed on the importance of obtaining complete information on the operation of engines in the airplane over the entire flying range, particularly in the case of the high-speed airplane. The writer sets up certain characteristics of aircraft engines that affect carburetion. These are:

(1) Since the engine operates on air, the carburetor must meter the fuel in proportion to the weight of air burned, which has a direct relation to indicated horsepower output.

(2) Engine air consumption and, therefore, fuel consumption bear no fixed relation to brake horsepower or brake specific fuel consumption.

(3) Since the carburetor meters on the basis of airflow, there is no fixed relation between carburetor metering and brake specific fuel consumption.

The aircraft carburetor has certain functions that can be summarized as follows: It should meter and mix fuel in a selected proportion to the weight of air consumed by the engine; it should provide fuel-air ratios for all flight operations; it should incorporate an acceleration system that will allow the pilot to open and close the throttles at any rate, load, altitude, and frequency; it should meter satisfactorily with many types of fuel systems, at any airplane altitude.

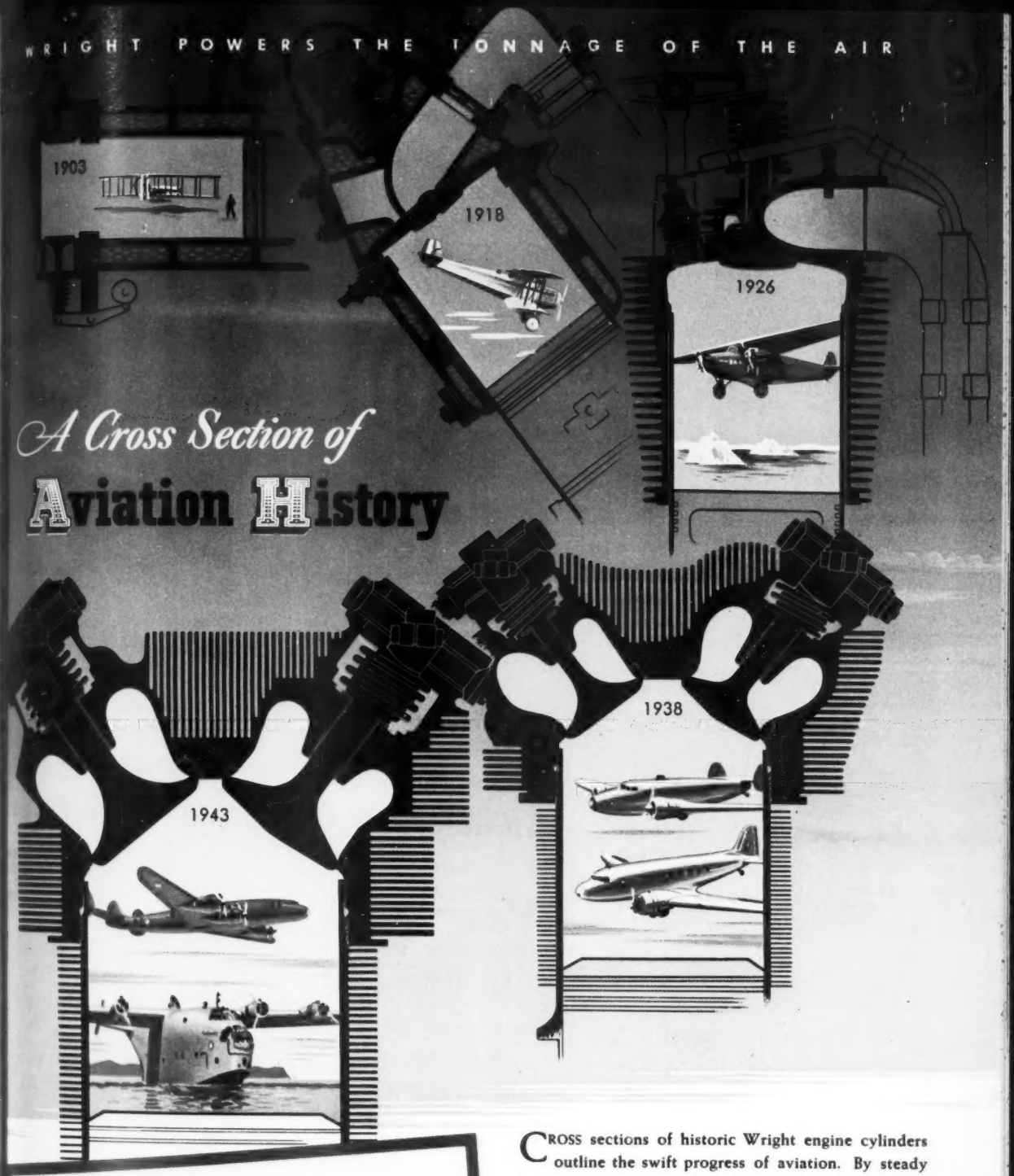
If such severe conditions are to be met, it is obvious that the highest skill is required. Even when the best techniques of today are followed, it cannot be expected that the present carburetors can meter to closer limits than ±5 per cent over the entire engine operating range. *S.A.E. Journal*, August, 1943, pages 294–303 (Transactions), 13 illus.

Packard Powers Mosquito. A brief article on how the Packard Company builds Rolls-Royce Merlin engines. Information pertains to the number and machining of engine parts, the need for precision, and the new machinery and equipment that had to be installed for the purpose by the Packard Company. Other topics are the cost and time of machining aircraft engine parts as compared with the cost and time for automobile engine parts, some characteristics of the Rolls-Royce engine, and testing and packing methods. *Canadian Aviation*, July, 1943, pages 45, 56, 1 illus.

Inspection

Radiography of Aircraft Spot-Welds. Robert Taylor. An analysis of radiography as an inspection method for testing spot welds begins with two questions concerning the important factors to be considered—namely, the

WRIGHT POWERS THE TONNAGE OF THE AIR



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1943 World's largest transports, the Lockheed Constellation and the Martin Mars use 2000 H.P. Cyclones. Many outstanding military planes, such as Boeing Flying Fortresses, were developed around the Cyclone.

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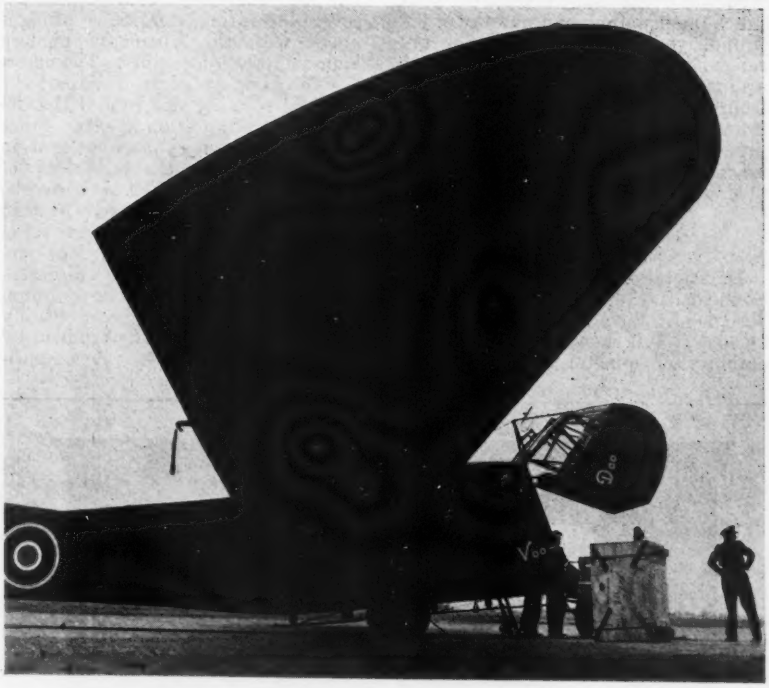
most satisfactory technical procedure for securing acceptable radiographs and some of the newer applications to be tried in this kind of word. The standards governing spot welds are briefly reviewed and advice is given on the selection of film. Two of the most important factors are listed as intensity of the emitted radiation from the x-ray tube and the radiographic distortion. Rules are established for determining the correct intensity and for avoiding distortion. The proper type of x-ray tube is discussed as another important factor, with illustrated examples showing differences in definition and radiographs of satisfactory welds. The distinction between photographic density and specimen density is emphasized.

Conclusions are drawn as follows: (1) Film should have the finest possible grain size; (2) a source-film distance of at least 12 in. should be maintained; (3) a rotating target tube would furnish the optimum in recorded definition and should be selected for exceptionally fine focus and high current capacity; (4) a window in the tube envelope should preferably be made of beryllium for easier passage of the radiation to the film. *Aero Digest*, July, 1943, pages 263, 265, 266, 283 8 illus.

Douglas Streamlined Inspection System Speeds Production. C. C. Harrison. A description is given of how Douglas formulated an inspection system that would clearly define, on a centralized inspection form, all detailed instructions necessary to control quality. Methods of fixing responsibility and reducing inspection time are outlined. Typical inspection cards listing detailed instructions are illustrated and described, as well as the system used for filing the inspection cards. The writer explains how the card system has proved its superiority over the system previously used. *Automotive and Aviation Industries*, July 15, 1943, pages 24, 25, 92, 3 illus.

An Inspection Revolution by "Bristol's." Based upon a formula for converting sample averages into control limits, a new system of "quality control" inspection for certain classes of work has been employed by the Bristol Aeroplane Company. This article presents a general description of the system and offers an explanation of its mathematical basis. Both it limitations and advantages are analyzed. Offering a solution to the problem of accelerating inspection with fewer skilled operators engaged on the work, the system is said to yield: the reduction of scrap; a saving in the employment of highly skilled labor on inspection routines; greater uniformity of product; a larger volume of production at no increase in cost; the early detection of trouble in production; avoidance of trouble by anticipating changes in quality; and an authentic record of the quality of the product. Specimen control charts illustrate how variations in the quality of output are recorded. *The Aeroplane*, July 2, 1943, pages 12, 13, 4 illus.



Carrying a full load of freight, the glider "Voo-Doo" was recently towed 3,220 miles across the Atlantic to England in 28 hours by an R.A.F. Transport Command plane. The wingspread is only 85 ft.

Instrument Flying

Flight by Instrument. Capt. John O. Stewart. A compendium of the basic instruments for "blind" flying. Illustrations of each instrument are accompanied by a description of the instrument and its function. For further understanding, a simulated emergency flight is followed through conditions that demand full use of the various instruments. *Skyways*, August, 1943, pages 39–51, 31 illus.

Instruments

Aircraft Loading—A Problem of Today. Lloyd F. Kernkamp. Problems connected with the loading of aircraft are discussed, and the use of the Librascope balance computer for solving loading problems is described. It is explained that given the actual empty weight of the airplane and the actual empty weight c.g. positions, plus the weight of each load, the c.g. positions for any possible combination of loads can be readily determined with the Librascope. It is stated that, while the present Librascope is used largely in connection with airplane loading, among the problems that can be solved with this instrument are those of hydraulics, meteorology, strength of materials, aerodynamics, and thermodynamics. *Weight Engineering*, Spring, 1943, pages 46–48, 1 illus.

Kompass-Steuerung "Kurs" (Compass Control "Kurs"). Hans Kuhn. A new device to control the direction of flight of model airplanes has been developed in Switzerland. A compass needle turns between two hardened steel points, and the bearing of the lower point contains a drop of mercury which is used to control the flow of the electric current. On the axis of the needle is a contact transmitter that closes the contact when the flying model varies its direction from the predetermined course. The actual control element consists of a stator and a rotor. Attached to the rotor is a double lever that controls the rudder. Electric current is provided by a small dry battery. The entire outfit, including the battery, weighs about 5 oz. *Schweizer Aero-Revue*, April, 1943, page 127, 5 illus.

Jet Propulsion

Jet Propelled Helicopters. Cedric Giles. A review of various possible methods of applying jet propulsion to helicopters. The writer discusses air-jet arrangements, combustion gas ejection, propeller jet propulsors, and methods of jet propulsion incorporated in the Papin-Rouilly gyropter. Developments based on reaction-driven rotors also are considered. *Astronautics*, July, 1943, pages 5–9, 2 illus.

Fairey Jet Propulsion System. A brief description is given of a British patent on thermal jet propulsion for aircraft recently granted to Capt. A. G. Forsyth, assignor to the Fairey

Aviation Company. The patent proposes the installing of a number of jet propulsive units in the tail or arranged in line in the wing section of ordinary aircraft, with inlets starting from the leading edge. A sectional drawing of this Forsyth-Fairey jet propulsion device is shown. *Astronautics*, July, 1943, pages 10, 12, 1 illus.

Lubricants

Deterioration of Lubricating Oils—Soybean Lecithin as an Inhibitor. Joseph J. Jacobs and Donald F. Othmer. It is shown that the natural stability of mineral lubricating oils has not been enough to withstand the severe operating conditions brought about with the advent of modern high-compression engines. The necessity for using additives to impart the required stability has caused the development of addition agents. Since many of these synthetics contain critical materials, the possibility of using a natural product was investigated. Commercial soybean lecithin is an oil-soluble material containing phosphorus and nitrogen, two elements claimed to have desirable properties in additives. The optimum concentration of this cheap, readily available material was determined by the Sohio oxidation test. A comparison with other commercial additives and the effectiveness of the lecithin in different base stocks and oils of different viscosities was made. Some observations of the effect of method of refining on the stability of oils are noted. The conclusion is reached that the mixture, known by the trade name "Gliddol," reduces the amount of naphtha insolubles formed, as well as the viscosity increase and the neutralization number. It is effective in oils from widely varying base stocks, in oils refined by widely varying methods, and in oils of different viscosity indices. It compares well with several commercially accepted inhibitors. *Industrial and Engineering Chemistry*, August, 1943, pages 883–889, 4 illus.

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Maintenance

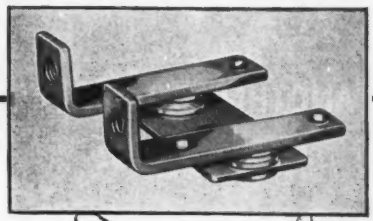
International Overhaul. A survey of the operations of Aircraft Repair Ltd., a repair base at Edmonton which services and overhauls airplanes and airplane engines for Canada, the United States, and Britain. After briefly reviewing the background and development of the company, the article goes into greater detail about its maintenance and overhaul procedures, facilities, and equipment. Particulars are included on the work of the field service units, engine overhaul shop, inspection group, testing department, stores division, propeller shop, and assembly groups. The following planes are noted among the 25 to 30 types handled at this Canadian base: Avro Anson, Airspeed Oxford, North American Harvard, Noordyn Norseman, Barclay-Grow, Beechcraft, and Bristol Bolingbroke. The engine types mentioned are: Armstrong-Siddeley Cheetah Nine and Ten, Jacobs L4M and L6M, Pratt & Whitney Hornet and Wasp, Wright Cyclone, and Continental. *Aviation*, July, 1943, pages 209, 211, 212, 343, 344, 347, 10 illus.

Management

What Incentive? Allan H. Mogensen. In this article the writer discusses wage or financial incentives under conditions as they exist today in most war production plants, rather than in other well-established firms where good management and high standards are taken for granted. Instead of wage incentives for the hourly worker in the war production plant, the writer proposes an active, top-management supported work-simplification or job-methods training program. He cites examples of incentive programs that failed to accomplish desired results and contrasts these with the increased production and other improvements obtained under the suggested plans. *Aircraft Production* (Los Angeles), August, 1943, pages 15, 32 illus.

Statistics in the Fight on Accidents. William S. Rhodes. An article

Every Part is Most Important at the Time It Does Its Job



What part of a plane is most important? Let the pilots tell you that. All we know that it is "most important" that every phase of the contact parts we produce is perfect and right for the job they do. The time may come when everything depends on the accurate functioning of those tiny contacts.

Contact materials are all important as one manufacturer discovered. He was making an amplidyne relay for airplane gun turret controls. The relay had to conform to rigid specifications and carry approximately 100 amperes of current. Trouble developed from the contact material specified. Under overload tests, the contacts stuck.

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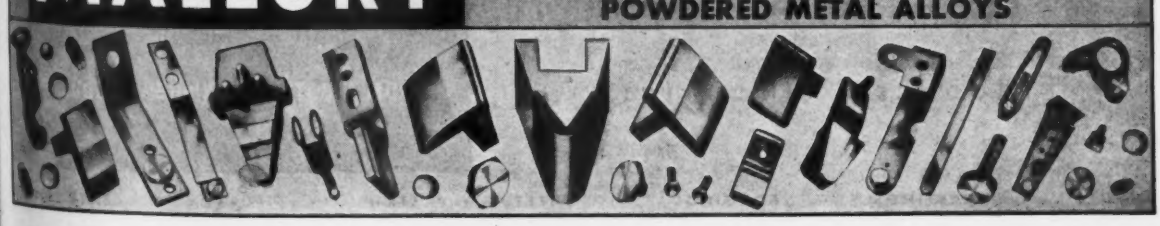

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on the use of accident records and statistics as a means of analyzing causes of accidents in the aircraft industry and reducing the number of future accidents. The description of a form used by Aircraft War Production Council members is included. This form not only gives the necessary information concerning circumstances of the accident but classifies the accident for statistical purposes as well. A coding system is used engendering four accident breakdowns: tabulation of accident causes, with 28 classifications; effect of injury, with ten classifications; parts of the body affected, with ten classifications; machine type, with 54 classifications; and management and worker responsibility, with five classifications. *Western Flying*, July, 1943, pages 47, 100, 1 illus.

Projecting Labor Loads in Aircraft Production. P. B. Crouse. It is stated that although the use and the effect of "learning curves" as an adjunct to labor-load projection in aircraft manufacture have been well established, relatively little has been published on the subject. In this article the subject is treated in a manner that is intended to provide for quick assimilation of the related principles and techniques. Reasons for high costs in aircraft plants are analyzed, and a system of labor-cost projection is suggested. A detailed explanation of the system is given, with charts, tables, and formulas. *Aircraft Production* (Los Angeles), August, 1943, pages 22–26, 34, 4 illus.

Materials

Wool Felt a Vital Ingredient in Airplane Construction. The applications of wool felt for airplane construction are examined and reasons are given for the expanding number of its uses. Indicating the quality variations of this material, properties peculiar to wool felt in both its natural and manufactured states are considered. The following are listed among its general uses: as supports for units where rigidity is not desirable; to prevent the transmission of destructive vibration; to seal various enclosures against leakage; to distribute lubricant to critical bearing surfaces; and as a protection against dents, scratches, and distortion. Contrasting with the conventional applications of felt as a cushioning material, its use in grinding, polishing, and finishing operations is described. For this type of work the felt is used in the form of wheels and bobs.

It is claimed that wool felt is available in various consistencies, that there is an abundant supply for wartime uses, and that it can be worked by simple methods without special manufacturing equipment. A low-weight material, it is suggested as an alternate for rubber, cork, and certain synthetics. *Aero Digest*, July, 1943, pages 271, 273, 281, 7 illus.

Avoiding Weak Points in Aircraft Construction. A. Dickason. It is emphasized that in the construction of aircraft it is essential that measures be taken to insure the highest standard of craftsmanship and the complete absence of weak points. The importance of the inspection department is stressed. The writer discusses the normalizing of Duralumin parts, which require working in the soft condition; the dangers of local heat-treatment; the cause of age hardening; annealing Duralumin; and the effects of immersion. *Sheet Metal Industries*, July, 1943, pages 1226–1228, 2 illus.

Medicine

The Hyperventilation Syndrome and Its Importance in Aviation. H. Corwin Hinshaw, Robert F. Rushmer, and Walter N. Boothby. A description is given of the symptoms produced by voluntary deep and rapid breathing which are characterized by dizziness, blurring of vision, numbness of the extremities and, in later stages, by muscular cramps, serious vasomotor collapse, and unconsciousness. These symptoms are produced by acapnia (the washing out of large amounts of carbon dioxide from the blood) and may result from spontaneous, unrecognized, hyperventilation occurring under conditions of emotional strain, excitement, and anxiety.

It is stated that the hyperventilation syndrome is now clinically recognized as the physiologic basis for some symptoms noted among persons of unstable nervous temperament but may also occur under conditions of emotional strain among those persons who have a normal nervous equilibrium. The symptoms are of such character as seriously to interfere with a pilot's ability to control an airplane should they occur during flight.

The results of extreme hyperventilation are well known, but it has not been adequately emphasized that similar results are produced by mild hyperventilation continued over a longer period of time. A few instances of probable, spontaneous hyperventilation among fliers have been described.

A marked variation in symptoms produced among different aviators tested by voluntary hyperventilation has been noted. The severity of symptoms is not related to the degree of acapnia produced.

It is proposed that the demonstration of voluntary hyperventilation be included as a part of the routine periodic medical examination of commercial and military pilots, so that these fliers may be trained to recognize the symptoms produced and to control them by voluntary suppression of respiration should they occur during flight. It is stated that if this plan were carried out on a sufficiently large scale it would be possible to determine how frequently spontaneous hyperventilation occurs during flight and to estimate its importance as a factor in the production of "pilot error." *The Journal of Aviation Medicine*, June, 1943, pages 100–104.

Decompression Disease of Bone. Lt. J. H. Allan. The paper describes in some detail the rare osseous lesions and joint changes encountered as a late manifestation of decompression illness. The available literature referring to changes in the skeletal system caused by decompression illness is reviewed.

It is pointed out that any obliterative process interfering with blood supply will initiate a process of aseptic necrosis if near a joint or will initiate the production of a bone infarct if occurring in the shaft of the bone.

The late effects of this process are recognizable roentgenographically. These features are: (1) aseptic necrosis involving hips and shoulders, (2) medullary calcification in the diaphyseal end of the long bones, and (3) hypertrophic arthritis. Not all of these features need be present in an individual to justify the diagnosis. Aseptic necrosis with osteoarthritis may occur without medullary calcification. Joint changes are more frequently present than changes in the long bones.

The recognition of such bone changes are of paramount interest in time of war, since the incidence of symptoms ascribable to decompression illness associated with high-altitude bombing and fighting are on the increase. *The Journal of Aviation Medicine*, June, 1943, pages 105–111.

Medical Service of the Service and Depot Groups, Army Air Forces. Col. John Hargreaves. A brief article describing the activities and medical services of the Air Service and Air Depot groups of the Army Air Forces. The personnel of the various units is outlined, with information on the duties performed. *The Journal of Aviation Medicine*, June, 1943, pages 112, 113.

The Extent of Water Loss by Rats at Lowered Barometric Pressures. Howard G. Swann and W. Doyne Collings. When making experiments with rats in altitude chambers, a marked and consistent weight loss was noted when the animals were exposed to altitude of 18,000 ft. for 6 hours or more. Because the phenomenon was so regular and striking, a more critical analysis was made. The paper describes the results of these experiments. *The Journal of Aviation Medicine*, June, 1943, pages 114–118.

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Some Physiological Aspects of Parachute Descent from High Altitudes. K. F. Penrod. Simulated parachute descents were made in a low-pressure chamber where the reactions of the subject could be closely observed. Both free-fall and open-parachute descent from 30,000 ft. were simulated in the low-pressure chamber, as well as free-fall descent from higher altitudes. In these experiments, twelve subjects "bailed out" at 30,000 ft. and opened their parachutes immediately. All but one reached the ground without loss of consciousness, and it is concluded that the one who did lose consciousness did so because of psychic rather than anoxic reasons. Fifteen subjects did a simulated free-fall from 30,000 ft. while holding the breath. The arterial oxygen saturation remained above 80 per cent in 14 cases. The fifteenth subject reached 73 per cent.

Twenty-three subjects performed simulated free-falls in the chamber from altitudes of 37,800 to 39,800 ft. while holding the breath as long as possible. The average time for holding the breath was approximately 35 sec., and all got down without loss of consciousness. The minimum arterial oxygen saturation of these subjects ranged between 60 and 76 per cent. Three subjects did not hold the breath at all, and all three lost consciousness and were given oxygen.

It is stated that the danger of breakage of ear drums in a free-fall descent is great but that it would not be so great if the parachute were opened between 15,000 and 20,000 ft. *The Journal of Aviation Medicine*, June, 1943, pages 119–125, 3 illus.

The Problem of Airsickness. Major Paul A. Campbell. The syndrome commonly referred to as airsickness is discussed. It is explained that the usual symptoms of airsickness are malaise, pallor, nausea, sweating, and, if in severe degree, vomiting. The symptoms are accomplished by a certain degree of inefficiency of mental and physical functions and, not infrequently, by prostration.

Since alteration in acceleration and direction is the primary excitant, this factor is discussed in considerable detail. Roentgenograms are shown of both normal subjects and subjects who have had a definite history of motion sickness, taken before and after 20 min. of motion in a mechanical device. Possible measures that can be taken to combat airsickness are outlined. *The Journal of Aviation Medicine*, June, 1943, pages 126–131, 4 illus.

Labyrinth in Aviation. Hans Brunner. The subject is discussed from the point of view of the clinician who has to deal with the labyrinth in ear diseases as well as in brain diseases. Problems connected with the labyrinth which have not been solved up to the present time are considered.

In flying, the labyrinth may be stimulated by (a) rotating motions of the airplane, (b) inclination, and (c)

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All of these operations are performed with the tool in a drill press spindle, the work being held by a simple fixture. The time saving between this method, requiring a single set-up and a single stroke of the drill press spindle, and the use of three set-ups and three tools is obvious.

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straight-away acceleration and deceleration in either horizontal or vertical phases or through a combination of both directions. These stimuli upon the labyrinth produce sensations and reflexes which are described and discussed.

It is concluded that the function of the normal labyrinth is of little help to the aviator. The labyrinth may offer actually false information. The subject of vertigo and immunity against it is discussed. The latter part of the article is devoted to the clinical examination of flying cadets. *The Journal of Aviation Medicine*, June, 1943, pages 132–150, 1 illus.

What Big Eyes, Grandma. Lt. Ken Lester. Presenting a simplified explanation of the structure of the human eye, this article is concerned also with some of the conditions that govern efficient eye functioning and reasons for some of the more common visual defects. Three defects that have to do partially with the shape of the eyeball are described: nearsightedness, farsightedness, and astigmatism. Discussing also depth perception, color perception, and night adaptation, the writer indicates the importance of each of these visual abilities to airplane piloting. *Air Facts*, August, 1943, pages 13–18.

Souping Up the Pilots. Mary Parker. Proper diets for fliers and their importance to flying efficiency are discussed. From a survey of the diets prescribed for and followed by American and British military and civilian pilots, the writer reports on the foods they eat, with regard to caloric requirements and the proper balance of mineral and vitamin content. She also notes the special nutrition problems of naval aviators, night flying, high-altitude flying, and combat flying. Her conclusion is that the qualities that make a good pilot are not dependent upon caloric intake. *Skyways*, August, 1943, pages 25, 62, 78, 82, 5 illus.

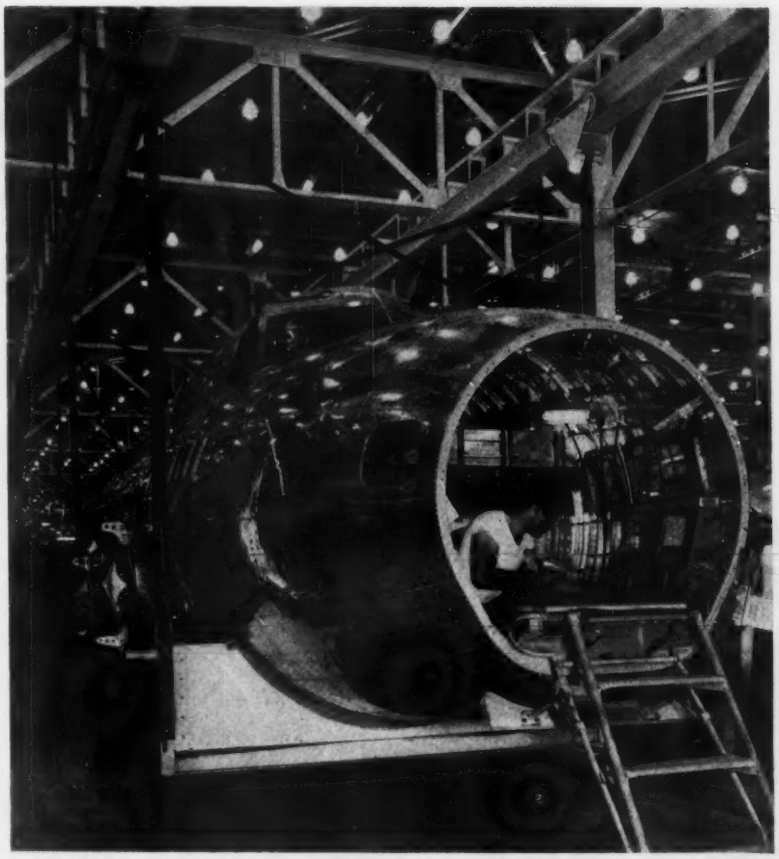
Metallurgy

The Metallurgy of Modern Alloys. R. H. Harrington. This is the seventh of a series of articles on heat-treating definitions for modern alloys. The writer continues a discussion of reactions in the solid state of alloy systems. Subjects covered include peritectoid reactions and pseudocompounds. Conclusions for solid state reactions are furnished. *Heat Treating and Forging*, July, 1943, pages 336–338, 350, 351, 4 illus.

Military Aviation

Those Claims Are Right. Myles V. Cave. A review of the combat performances of English and American planes on the African and European fronts. In Europe the actions of the Flying Fortresses and Liberators are noted. The writer affirms that any criticisms of American claims as to the number of enemy planes downed by these two bomber types can be discounted. He describes the flying formations used for these bombers which differ from R.A.F. formations because of their gun locations, giving that as a basis for some of the controversy. For the African action, comments are made on the performances of the following planes: Mitchells, Marauders, Lightnings, Warhawks, Mustangs, Spitfires, and Hurricanes. Special features of these airplanes and the purposes for which they were particularly utilized are reported. The article also mentions the development and advantages of ferrying fighters—such as the Lightning, the Warhawk, and the Thunderbolt—direct to their transoceanic destinations.

Notes are included on the performances of American and British airplane engines and the creation of new possibilities by the Merlin 61. Another subject touched upon by the article is the question of air transportation in postwar peace problems. A continuation of the cooperation between the United States and Great Britain and an immediate agreement for the basis of coordination are advocated. *Aviation*, July, 1943, pages 116–118, 374, 3 illus.



The front section of a Flying Fortress fuselage moves along the Douglas assembly line in a cradle suspended from overhead carriers. The portable fluorescent lighting fixture, shown in the interior of the nose, contains outlets for various electrical tools. (*See* page 79.)

"Better Than Six For One." Capt. Thomas G. Lanphier, Jr. An American fighter pilot gives his views on why groups of United States fighter planes are able to defeat Japanese fighter groups by such wide margins. In addition to the lack of pilot-protection afforded by the Zero and its inflammability, he claims that two other factors are mainly responsible: the absence of teamwork between Japanese fighter pilots and the fact that present Japanese pilots are not so well trained as the men who were encountered earlier in the war. *Air Facts*, August, 1943, pages 9–11.

The Flying Flak Ship. Keith Ayling. It is stated that until heavily armored, long-range fighters capable of convoying bombers to their targets are put into the air, regular daylight bombing raids cannot be undertaken without increasingly heavy losses. The suggestion is made that the Flying Fortress with augmented armament instead of bomb load may be the answer to the convoy fighter problem. How the Flying Fortress might be equipped and used for this purpose is described and illustrated. *Air Trails*, August, 1943, pages 20, 21, 86, 88, 5 illus.

The WIAC ...helping free men for active duty, too

When considering the important contribution that women are making towards the war effort, don't overlook the Women's Industrial Auxiliary Corps.

Like their sisters in the service auxiliaries, these women workers in aircraft factories—and in practically every other type of war plant—are today doing many of the "tremendous trifles" so important to the construction of warplanes.

Here, American Flexible Shielded Conduit is being made ready for final assembly into a medium bomber built by a prominent Eastern plane builder. Threading electrical wires through the conduit and soldering on end connections was formerly done exclusively by men. Today, however, with a minimum of training, women are doing the job equally as well, and in many cases, faster.

American Flexible Low-Tension Shielded Conduit is used by every combat plane builder in this country. Hundreds of feet of this material in sizes ranging from ⅛" in diameter to 2½" in diameter shield the electrical wiring system so that radio interference is eliminated and signals clearly heard.

Allied with this line of Shielded Conduit, made to both Army and Navy specifications, is American's complete line of Shielded Conduit End Connections and Fittings for use in the electrical system. Fittings in accordance with AC, NAF and AN specifications are constantly rolling out of American's machines in larger and larger quantities.

American also makes flexible tubing in stainless steel and aluminum for use as hot air ducts and for conveying exhausts on planes, as well as a complete line of flexible metal connections so vital to the continued maintenance of the modern aircraft plant.

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Naval Aviation

Patuxent River Naval Air Station—The Navy's New "Wright Field." E. M. Hockensmith. A description of the Naval Air Base at the junction of the Patuxent River in Maryland and Chesapeake Bay. Established first as an aviation experimental center and, second, as the East Coast's terminal for the Naval Air Transport Service, this station possesses facilities for both landplanes and seaplanes as well as piers for freight vessels. In addition to its war function, its activities are expected to be employed for commercial aviation purposes after the war.

Indicating some of the construction details of the Patuxent River Naval Air Station, the article depicts the various projects in the area. It also outlines the general setup of all U.S. Naval air stations. These are reported to consist normally of a main station, three or more auxiliary base fields, and 25 additional outlying landing fields. *Aero Digest*, July, 1943, pages 118, 119, 252, 4 illus.

The Evolution of Naval Dive-Bombing. William Thomas Larkins. By briefly describing the series of planes which have served the U.S. Navy as dive bombers, the development of U.S. Naval dive bombing tactics is reviewed. The United States is credited with being the first country to found and develop operational use of dive bombers and the U.S. Marine Air Corps is said to have originated the practice in 1919. Photographs illustrate the successive dive-bomber types which have been used by the U.S. Naval and Marine air forces from 1919 to 1943. A note states that all current naval planes, except torpedo and patrol planes, operate as dive bombers at different times and that all of our modern naval fighters are built to withstand the strain of terminal velocity dives. *Skyways*, August, 1943, pages 21–24, 86, 21 illus.

Naval Air Dockyard—I. The beginning of a two-part article detailing the origin and operations of Royal Naval Aircraft Repair Yards. Organized on the principles of naval dockyards, these yards are depots where damaged aircraft of the British Fleet Air Arm are repaired. When an impaired airplane arrives at a depot it is assigned to one of three classifications: turned into salvage; sent to the appropriate department for "specific repairs"; or submitted to the "flow system," which means that the entire plane is dismantled and reassembled, with any irreparable parts being replaced. The article traces the latter procedure, showing what happens to the components of the plane as they go through various departments such as the Re-issue Stores, Stripping Section, Inspection Department, Tank Shop, Airscrews and Propellers Section, Engine Repair, Machine Shop, and Sheet Metal Shop and Assembly Department. A source of trouble noted as characteristic of naval aircraft is the prevalence of corrosion, particularly with the electrical services, in the planes which come to the Royal Naval Aircraft Yards for repair. *The Aeroplane*, June 18, 1943, pages 699–701, 10 illus.

"Oil Slicks." Lt. Fred Tupper. An account of how auxiliary aircraft carriers are ferrying boatloads of planes to war theaters. It is noted that these carriers are effective for patrol and can be used offensively. *Air Trails*, August, 1943, pages 24, 99, 100, 3 illus.

Personalities

Chennault—The Army Couldn't Defeat Him. Cy Caldwell. The writer asserts that animosity and resistance have followed Major Gen. Claire Chennault throughout his military career with the U.S. Army. Presenting his views on the reasons for this, he traces the highlights of the General's career to show that he is still encountering the same prejudices that hampered him years ago. Chennault's tactical brilliance and achievements are lauded and, in conclusion, it is proposed that he be given merited full power over the U.S. Air Forces in China, unimpeded by any long-range control from the general ground staff in India. *Aero Digest*, July, 1943, pages 112, 114, 115, 373, 377, 5 illus.

He Flew Through the Air. James E. Foster. This is a brief biography of Lincoln Beachey, remembered by the writer as the greatest aerial showman of his time. An illustration shows the 1911 rotary-engine airplane in which he attained an altitude of 11,578 ft. *Air Trails*, August, 1943, pages 33, 100, 1 illus.

Personnel

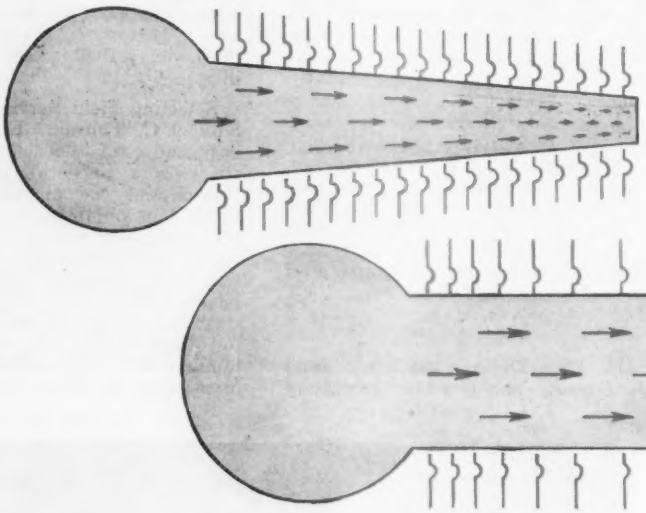
Accident Proneness. Some nonstatutory precautions for minimizing factory accidents are advised. Suggestions refer to: selective examination of new entrants, with the elimination of people who are physiologically prone to accident, such as epileptics; the consideration of physical characteristics and capabilities such as height, reach, and vision in the assignment of personnel to certain machines and jobs; adequate instruction to the worker in the care and use of his particular machine; protective equipment; and the treatment of injuries. *Aircraft Production* (London), July, 1943, pages 328, 329, 1 illus.

Selecting Field Service Personnel. Samuel C. Timson. Explaining the importance of the field representative's work to both the Army Air Forces and the manufacturer who sends him out, this article outlines the necessary qualifications for efficient field personnel. It is stated that such personnel should not be selected from men who are merely specialists in one part of the airplane but from those who are thoroughly familiar with the construction and functioning of every component and

New safety booths installed by the Propeller Division of Curtiss-Wright decreases loss of man-hours through accidents when grinding and finishing propellers. (*See* page 135.)

New!

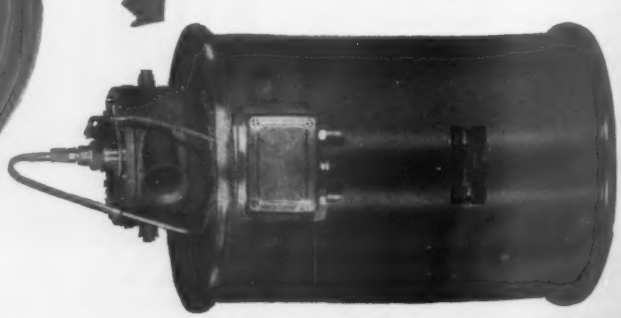
Another development by



How new tapered passage South Wind design *(left)* produces uniform heating over entire surface—contrasted with falling off in transfer with straight passage.

For compactness, "accelerating-flow" South Winds have transfer surfaces rolled into spiral form. Note steady decrease in cross-section.

The result! A compact 22-pound unit, 10 inches in diameter, up to 230,000 Btu/hr. output! Other models show similarly favorable ratio of output to size and weight.



basic heating by South Wind!

New "accelerating flow" design delivers even greater volume of heat ...cuts bulk and weight!

AGAIN Stewart-Warner South Wind Heater engineers have originated a major contribution to heating science! A development which for the first time makes every inch and pound of heating surface operate at full efficiency.

Throughout history, combustion devices have been limited in their output by the critical temperature of the metal most exposed to heated gases—while remoter surfaces operated at as little as 20% of maximum safe limits.

Now—by design which forces steady acceleration of combustion gases, South Wind engineers attain uniform heat-transfer coefficient *over the whole surface*. While most-exposed areas are held within critical limits, a new *spiral* design forces more remote surfaces to "scrub" more and more heat from escaping gases.

Thus the most remote transfer surface is stepped up to full utilization. And heat output per unit of surface reaches new record level while weight and bulk of heating units are still further reduced.

• • •

While the implications of this new development extend to every heating field, its present importance is in meeting aviation heating needs.

Ever since aviation experts set out to give American combat planes their present record ceilings, South Wind engineers have been privileged to cooperate closely on the new heating problems encountered, and to contribute by developing better heating from lighter, more compact units.

With the development of this new South Wind design, and the resulting increase in heat-transfer efficiency, South Wind is again able to offer stepped-up heat output from even smaller sources.

For example—up to 230,000 Btu/hr. output from a South Wind only 10 inches in diameter—15 inches long before adding duct connections—and weighing only 22 pounds!

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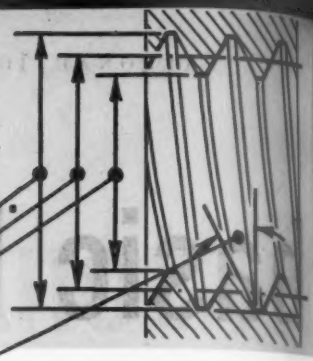

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SPIRAL FLUTE TAP used for fast cutting of SAE steels. Self cleaning and highly efficient on certain materials. Right or left hand flute.

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whose knowledge is not confined to one particular make of aircraft. The necessity for their being diplomats and salesmen as well as engineers, mechanics, and organizers is shown, and it is further specified that they should be personable. . . . possess initiative, judgment, and the character to command respect . . . . be able to solve all types of service and maintenance problems . . . . and have a working knowledge of the A.A.F. The discussion touches upon the question of how to obtain qualified field personnel. *Aero Digest*, July, 1943, pages 158, 293, 369, 373.

Plants

Airline Fire Protection. Fred A. Page. This article is from an address to the National Safety Congress. In it the writer discusses methods of reducing fire hazards to a minimum, giving particular attention to the problem as it affects air lines. The four factors that he considers most important are: the proper training of personnel; rigid enforcement of safety practices; keeping fire hazards in mind when buildings and other equipment are built; and adequate fire-fighting equipment. *Western Flying*, July, 1943, pages 46, 98.

Plastics and Plywood

Plastics and Metals for Structural Units . . . A Critical Comparison. John S. Trevor. Reasons are given why comparisons of plastics with metals can be misleading. It is stated that metals are inorganic and stable and that the physical properties for a wide range of materials are known to a high degree of accuracy. Plastics are organic and variable. They are not simple substances. There may be several substances present in the resin, any one of which can affect its physical properties. Published results pertaining to one particular resin may not apply to an apparently identical product manufactured at a different plant.

In the case of metals, it is possible to calculate how certain types of structural steel will stand up to various stresses and temperatures. This is not usually possible in the case of plastics. It is stated that the results of laboratory tests of plastics should be regarded as strictly empirical and forming only a basis for the selection of suitable materials. *Aeronautics*, July, 1943, pages 36, 37.

Low-Pressure Molding of Laminates. F. P. Wilson and N. D. Hanson. It is noted that after several years of intensive research it is now possible to mold laminated structures at low pressures and at reduced temperatures with a consequent reduction in molding time. Low-pressure laminating molding is defined as a means of distributing a relatively uniform low pressure over a prearranged, resin-bearings, fibrous assembly of cellulose, glass, or asbestos, with or without the application of heat from some external source to form a cohered laminated structure possessing definite physical properties. Thus, the low-pressure molding of laminates supplements high-pressure molding and, therefore, enlarges the field of application for high-strength molded laminated plastics.

Factors that should influence applications of the low-pressure molding process are mentioned. Five systems of low-pressure molding now in use are listed. A table shows the general types of resins used in low-pressure molding. The mechanical properties of cloth, paper, fiber, and fiber glass laminates are listed and discussed. *Modern Plastics*, August, 1943, pages 57–60, 144, 15 illus.

Tables of the Properties of Aviation Plastics. A series of tables lists representative plastics available for aeronautical applications. The listing shows the manufacturer, type, and aeronautical applications of each plastic, as well as its general, mechanical and physical, chemical, thermal, and electrical properties. *Aero Digest*, July, 1943, pages 186, 187–189, 232, 233.

Properties of Laminated Phenolics. L. E. Caldwell. The purpose of this article is to give the more important physical properties of laminated phenolics and, to a limited extent, to compare them with the corresponding properties of other materials.

It is explained that the different grades of laminated phenolics have inherent characteristics that are imparted from the materials from which they are made. The electrical and mechanical properties of the different grades are listed and discussed. As a means of providing a better understanding of the physical properties of laminated plastics, the methods of loading to obtain the greatest strength are considered. A table is furnished comparing the physical properties of paper laminates, fabric laminates, woods, and metals, such as aluminum, stainless steel, and magnesium. Definitions used as a key to the directional loads given in this table are presented. Illustrations show right and wrong methods for determining directional loads. Characteristic curves for typical laminated phenolics are shown. Significant physical tests made on laminated phenolics are described. *Modern Plastics*, August, 1943, pages 82–87, 138, 11 illus.

Pregwood in Aircraft. Data are given on the characteristics, composition, advantages, and aircraft applications of "Pregwood." A high density plywood, "Pregwood" is claimed to have strength factors far beyond those of normal plywood. It is said to combine lightness in weight with high moisture-resistance, dimensional stability, and durability. Pregwood is built up of wood laminates that are thoroughly impregnated with thermosetting resins and cured under heat and great pressure. One of its primary uses is for propellers, but in addition to propellers, blades, and similar parts, Pregwood is used also for parts of air frames. *Commercial Aviation*, June, 1943, pages 60, 62, 2 illus.

Tubing and Tube Fittings. During the last year, the use of plastics for aircraft piping has been seriously considered by several manufacturers. It is held to be evident that such materials could be used in many applications, and the methods by which they are produced would save much of the time required to produce corresponding metal parts. The plastic fittings used would be 50 per cent lighter, and the nonstrategic tubing material would conserve a large amount of aluminum tubing.

Although the advantages of plastic fittings in general overshadow their disadvantages, if care is not exercised in their use, serious consequences could result to both users and producers. It was thought, therefore, that the matter should be controlled with respect to materials, applications, and especially designs by providing designers with information that will result in the maximum utility of the molds and parts produced therefrom.

The problem of standardization was assigned by the National Aircraft Standards Committee to the Douglas Aircraft Company, Inc. The details of this test program are presented. *Modern Plastics*, August, 1943, page 64, 2 illus.

Plastic Bonding of Metals. Details are given on the Redux process, a bonding method for light alloys and steel which is based upon the use of synthetic resin adhesives. Developed by Aero Research, Ltd., this process is claimed to produce a stronger joint than that obtained through riveting. It is said to be both economical and conformable to modern production methods. The method is one of resin-bonding applied by a technique involving accurate control of variables but adaptable to the nature of the surfaces to be jointed and to the character of the structure to be assembled. *Aircraft Production* (London), July, 1943, pages 313, 314, 3 illus.; "The Redux Process for Bonding Metals," *Sheet Metal Industries*, July, 1943, pages 1209, 1232, 3 illus.

Aircraft Applications of Plastics. Lt. C. L. Fell. The writer reviews the steps that were taken in the development of all-plastic airplanes. He traces the experimental work that was done in finding the type of synthetic resin currently used in place of other types of adhesives used in earlier years. The difficulties encountered in this research work are related, with reference to the various parts of the aircraft. The application of low-pres-

sure molding methods to the making of secondary structural parts is recounted, and a description is given of the methods of low-pressure molding. It is stated that work is now under way in the design of a wing structure using high-strength, paper-base laminates. It is concluded that it will be necessary to attain satisfactory mechanical properties and that only by the attainment of these properties can the most efficient plastic structure be built to compete with a metal unit. *Modern Plastics*, July, 1943, pages 89, 90, 128, 6 illus.

Creep in Aircraft Plywoods. John Delmonte and E. Watkins. In a contribution to the relatively little-published data on creep characteristics of aircraft plywoods, it is stated that numerous variables such as grain direction, moisture content, resin adhesives, and laminating conditions will influence creep characteristics in much the same manner as they affect other physical properties. In addition to dimensional changes under sustained physical stress, another factor dealing with the changes caused by variation in moisture content is reported. The article covers this factor, which is defined as a condition where plywoods of uniform moisture content are exposed in such a manner that one surface evaporates moisture while the other remains unchanged.

Experiments are reported in which the number of variables is kept at a minimum. The materials and methods employed in the tests are described and the results are summarized. It is noted that for the samples tested, the ratio of initial deformation to creep under load is a constant factor at any given time but for a wide range of stress. Distortion as a function of the moisture gradient was found to be quite pronounced. The writer concludes that insufficient tests have been performed to suggest correct manufacturing procedures for preparing plywood with minimum creep, but further experiments are contemplated. *Aero Digest*, July, 1943, pages 306, 307, 365, 3 illus.

Post-Forming Thermosetting Products. The H. J. Heinz Company recently announced the development of a method for molding or postforming phenol-formaldehyde laminated sheets after they have reached the stage where formerly they were considered definitely thermoset and impossible to remold and shape. Highlights of this process, which is used in the production of airplane parts, are reviewed. Results of tensile tests of phenol-formaldehyde laminated sheet are tabulated. *Modern Plastics*, August, 1943, pages 70, 140, 2 illus.

Postwar Aviation

Post-War Aviation Problems. John Dwight Sullivan. The need is stressed for collaboration among the United Nations for the planning of peaceable and mutually beneficial international postwar aviation. These plans are outlined as follows: (1) The question of any nation having the right to exercise "sovereignty in air space" should be removed, since, it is stated, complete sovereignty cannot be exercised. (2) The notion that any nation can obtain by law, treaty, or international agreement such a mastery of the air that it will dominate international aviation to the exclusion of other nations also should be removed. (3) Freedom to American planes to fly over the territory of other nations, to land for the purpose of picking up or discharging passengers and goods, or to refuel will depend upon the extension of reciprocal rights to the planes of these other nations to fly over or land upon United States territory for the same purpose. (4) Islands that may be governed for a long period after this war under international mandate should be made available to the airplanes of all nations upon the same terms. (5) The fact that any nation has been required to establish military airports for strategic purposes during this war in parts of the world outside its own territory should not be considered to have given that nation an exclusive or even a dominant right to control international commercial aviation in those territories after the war. *Flying*, August, 1943, pages 26, 27, 32, 2 illus.

Ceiling Limited? W. A. Patterson. Decrying overoptimistic predictions with regard to postwar air transport, the President of United Air Lines presents a rational analysis of the potentialities of air cargo. Examining the relative cost of freight transportation by surface and air, he gives examples in which he shows that the cost of airplane operation is 35 times as much as freight-train operation and the ton-miles-per-hour results are the same. Mr. Patterson estimates that the number of planes which will be in air-line operation within ten years following the end of the war will be approximately 5,000. *Skyways*, August, 1943, pages 17, 64, 80, 7 illus.

Aviation Planning—Too Little, Too Late? First of a series of articles analyzing the problems of postwar readjustment in the aircraft industry. This installment indicates the extent to which the industry's output and income may be curtailed and the effects of such curtailment upon the national economy, with its attendant release of millions of workers. The uncertainty over future governmental policy, the limited reserves of aircraft companies for the maintenance of large payrolls, the acquisition of Government-owned plants by airplane companies, and the possibilities of the Government taking over operation of aircraft plants are discussed. Although conceding the advantages of Government regulation, the writer protests strongly against actual absorption and operation by the Government. *Western Flying*, July, 1943, pages 48, 49.

New Horizons in International Air Transport. Howard P. Whidden, Jr. The influence of international air transport on the nature of the postwar world is discussed. Consideration is given to air transport of the future and possible postwar routes. Five main alternatives for the postwar regime governing international air transport operations are set forth.

One phase in the construction of the Timm N2T-1 primary trainer. Workmen lay strips of spruce wood 1/24 in. thick over the form and apply tape to hold temporarily. Other layers are applied and all inner surfaces are coated with plastic material.

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Long before Pearl Harbor, Reynolds anticipated coming events—the need for a great new source of aluminum. So, Reynolds staked all its resources to fill this need—to mine its own Bauxite—to build mammoth new plants.

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Yes now our fliers have both feet on the ground because years ago we had our heads in the clouds, saw what was coming and did something about it.

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AIRCRAFT FINISHES

Further postwar problems considered include plane production, the use for war-built bases, and private versus Government ownership. *Foreign Policy Reports*, July 1, 1943, pages 90–99.

S. B. A. C. and Air Transport. The main points of a memorandum from the Society of British Aircraft Constructors to the British Prime Minister on the future of British Air Transport are reviewed. Presenting the proposals of this group for the development of British postwar commercial air transportation, the memorandum is divided into three main sections: the scope of postwar air transport, postwar conditions, and planning for postwar conditions. The last section is divided into consideration of the following points: Empire cooperation; ministerial control; monopoly or competition; provision of airliners; research facilities; training of technical staff; airports licensing of internal air transport; and operational data. Among the recommendations made by the Society are: the abolition of the single state-subsidized monopoly system and the encouragement of competition; the immediate building of transport-type airplanes; the provision for larger and more costly apparatus for research; and immediate governmental decisions with regard to the future ministerial control of civil aviation; licensing of internal air services; etc. *Flight*, July 1, 1943, page 7.

Tomorrow's Transports? Leonard Engel. It is stated that the planes with which the aviation industry will usher in its postwar age will be those that are quickly available. The planes that United States air lines will fly after the war are considered to fall into four categories. In the first group are models that the air lines had before the war which are still in production or of which production can be speedily resumed. Six examples are listed. The second category includes three models begun before the war but released for scheduled air service. The third group consists of two Consolidated military planes and a cargo plane based partly on the Curtiss Commando. In the fourth, if victory is delayed as much as another two years, are the Martin Mars; passenger planes based on the experimental Douglas B-19; and the first of the Kaiser-Hughes flying boats. The characteristics of the aircraft listed are studied. British aircraft suitable for postwar transport also are mentioned. It is stated that in aviation nothing is permanent and that the planes listed will give way within two or three years to the superliners now discussed so frequently. Remarks are made on these future designs and their power plants. *Air Trails*, August, 1943, pages 25–29, 8 illus.

Production

Letter to Berlin. Leslie E. Neville. This article is divided into two parts. The first, in the form of a letter to Hitler written by the editor, contains some comparisons of Allied and Axis aircraft production with regard to quantity, poundage, types, and rate of increase. Estimates of the monthly aircraft production rates of major nations on both sides are given, and the facts presented are illustrated. One chart shows the trend of monthly plane production for the United Nations and the Axis for the years 1941 to 1944 (latter part of the curve is based on estimated figures); another offers a comparison of monthly production in units of 1,000; and the third depicts the rising line of America's airplane poundage from 1941 to 1944, illustrating the letter's emphasis on the manufacture of long-range, heavy bomber types of planes.

The second part of the article is devoted to a discussion of when the rate of United States aircraft production should be leveled off. Factors of facilities, materials, and man power are considered. Stating that there must necessarily be a compromise between the military and civilian points of view, the writer places the figure for a convenient flattening point at about 10,000 planes per month. *Aviation*, July, 1943, pages 110–112, 381, 382, 3 illus.

De Havilland Mosquito. Wilfred E. Goff. This is the concluding installment of an article detailing the production operations employed in the manufacture of the de Havilland Mosquito. It deals with the wing assembly; the tailplane, fin, and flaps; the undercarriage; and the final assembly. The feature of the wing construction which is noted particularly is that the entire unit, with the exception of the small wing-tip sections, is built in one piece. Another departure from standard practice is indicated in the production of the undercarriage leg. This is the use of rubber blocks for shock absorbing instead of the more usual oleo-pneumatic arrangement.

Specific subjects of the description are: interspar structure, inner shell, top skin, wing removal, doping and installation, tailplane and fin, tailplane assembly, and flaps. Others concern the undercarriage leg, leg construction, leg assembly, final assembly, and final operations. *Aircraft Production* (London), July, 1943, pages 315–327, 38 illus.

Chevrolet Grey Iron Men Pour Magnesium. Franklin M. Reck. An account of how the Chevrolet foundry at Saginaw, Mich., has applied gray iron production techniques to the manufacture of magnesium castings. Patterned after gray iron methods, the pouring of the magnesium is accomplished on moving conveyers. In addition to details on these operations, the article describes the assembling of cores, molding, cooling, heat-treating, grinding, and touching-up procedures. The adoption of the automotive techniques is claimed to have increased greatly the production of the magnesium castings. *Aero Digest*, July, 1943, pages 190, 198, 204, 349, 6 illus.; "Latest Type of Equipment at Chevrolet's New Forge Plant," Joseph Geschelin, *Automotive and Aviation Industries*, July 15, 1943; pages 20–23, 94, 10 illus.

Better Methods. Nelson F. Metcalf. Industrial engineering methods employed by the Consolidated Vultee Aircraft Corporation are described. At the Vultee Field Division the work of setting up each job correctly has been concentrated in the hands of a "Better Methods" group of engineers who deal with the problem of work simplification. The article describes how motion studies are made with the use of a stop watch and motion-picture camera. *Aircraft Production* (Los Angeles), August, 1943, pages 12–14, 7 illus.

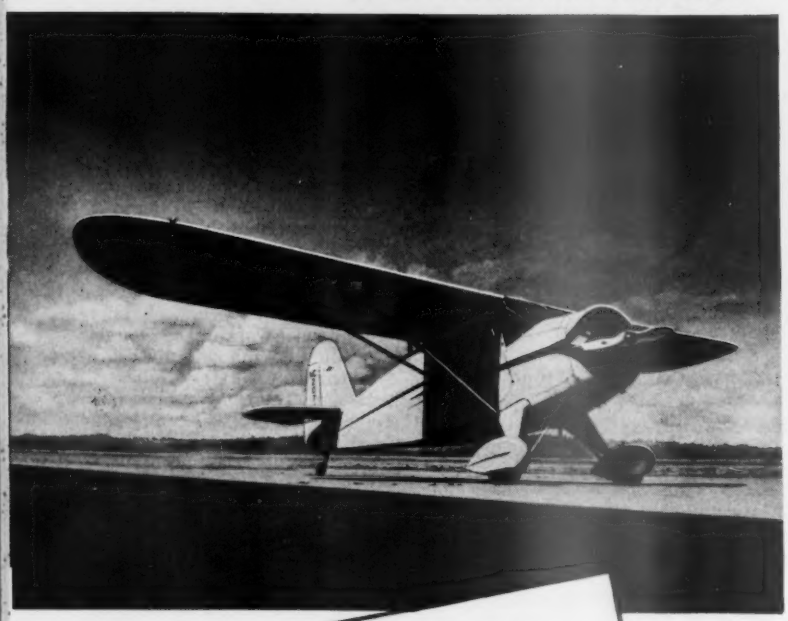
Fortresses by Douglas. George Tulloch. This article covers the methods, equipment, and systems created by the Douglas organization for the manufacture of Flying Fortresses. It describes how the Fortresses are built according to the Douglas plan of one long final assembly line instead of the several short lines used by Boeing. Tracing the actual flow of work in the Douglas plant, production innovations established by this company are indicated. As this is largely an assembly plant, with considerable fabrication done elsewhere, the innovations are chiefly in the dollies, jigs, testing devices, and conveyers. There are other innovations in machines such as those that do multiple drilling operations in partially fabricated parts. The importance of enconomy in energy and time is stressed as a guiding factor in the building of Fortresses by Douglas. *Aviation*, July, 1943, pages 130–135, 313, 314, 318, 16 illus.

Forming Rolls Important to the Aircraft Industry. This article explains the fundamentals of the operation of forming rolls manufactured by the Farnham Manufacturing Company, how they help to speed up mass production, and the economies that may be obtained through their use. A new development in these machines which enables the rolling of tapered as well as straight pieces is reported.

Information is also included on the Farnham mill countersinker. This is an automatic, semiportable machine for countersinking drilled sheets or extrusions to an accurate depth. *Commercial Aviation*, June, 1943, pages 90, 92, 3 illus.

"Fortresses" by Vega. H. E. Ryker. Presented in conjunction with two other articles on the manufacture of Flying Fortresses, this article is

FLEETWINGS and COMMONWEALTH for TRAINING...



Smoke IN THE SKY SPELLS Teamwork!

SMOKE SIGNALS are back in style again. Over Lae, and Dusseldorf, they mushroom up mile-high, eloquently signalling the end of Jap ammunition dumps or Jerry fuel tanks... every one subtracting days from the war...

These mile-high mushrooms are a sign of something else, too. *Teamwork.* Teamwork that ends with precision bombing runs the newspapers tell about. Teamwork between men and ships and nations, between pilots in training and their instructors... yes, and between *aircraft plants.*

Like the teamwork that is today producing a superlative American airplane for every fighting job. All the way from "puddle-jumpers" for liaison up to "trucks" for Pacific patrol. American aircraft are hitting their jobs on the nose, getting them done.

The four on this page are typical. Two of them battlewagons, two of them trainers. In national magazines, Roebling has told how each was conceived for its specific job... how, through their makers, the fledgling pilot as well as the bomber crew are getting the ships they need.

We at Roebling are proud of our part in that teamwork. Proud that in the big job ahead and the peace that follows, Roebling aircraft products will carry their part of the load.

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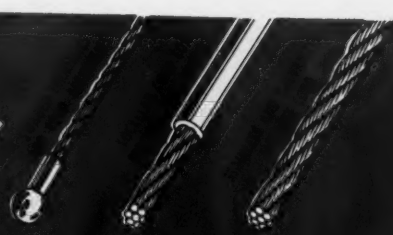

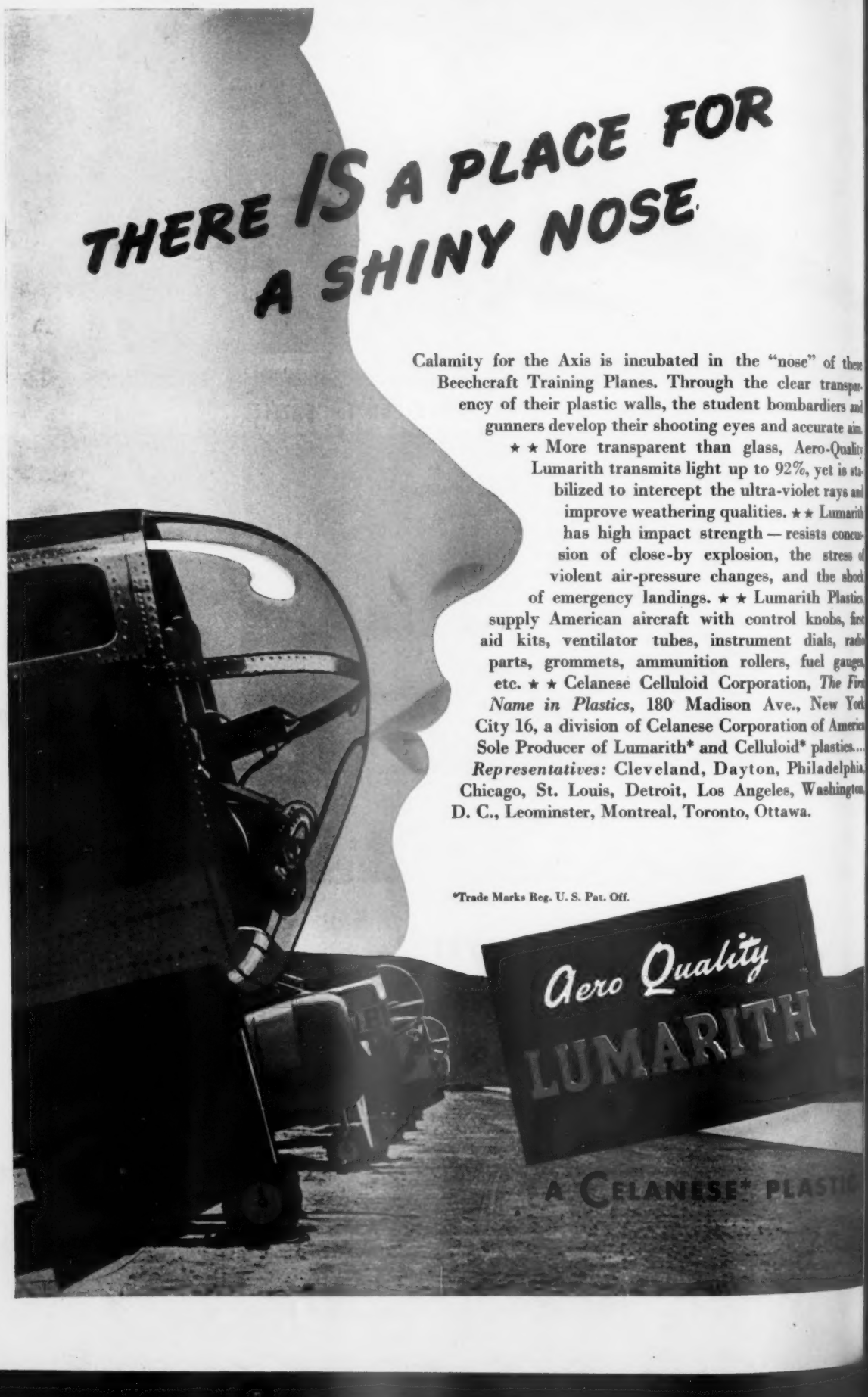

Calamity for the Axis is incubated in the "nose" of these Beechcraft Training Planes. Through the clear transparency of their plastic walls, the student bombardiers and gunners develop their shooting eyes and accurate aim. ★ ★ More transparent than glass, Aero-Quality Lumarith transmits light up to 92%, yet is stabilized to intercept the ultra-violet rays and improve weathering qualities. ★ ★ Lumarith has high impact strength — resists concussion of close-by explosion, the stress of violent air-pressure changes, and the shock of emergency landings. ★ ★ Lumarith Plastics supply American aircraft with control knobs, first aid kits, ventilator tubes, instrument dials, radio parts, grommets, ammunition rollers, fuel gauges, etc. ★ ★ Celanese Celluloid Corporation, *The First Name in Plastics*, 180 Madison Ave., New York City 16, a division of Celanese Corporation of America. Sole Producer of Lumarith* and Celluloid* plastics.... *Representatives:* Cleveland, Dayton, Philadelphia, Chicago, St. Louis, Detroit, Los Angeles, Washington, D. C., Leominster, Montreal, Toronto, Ottawa.

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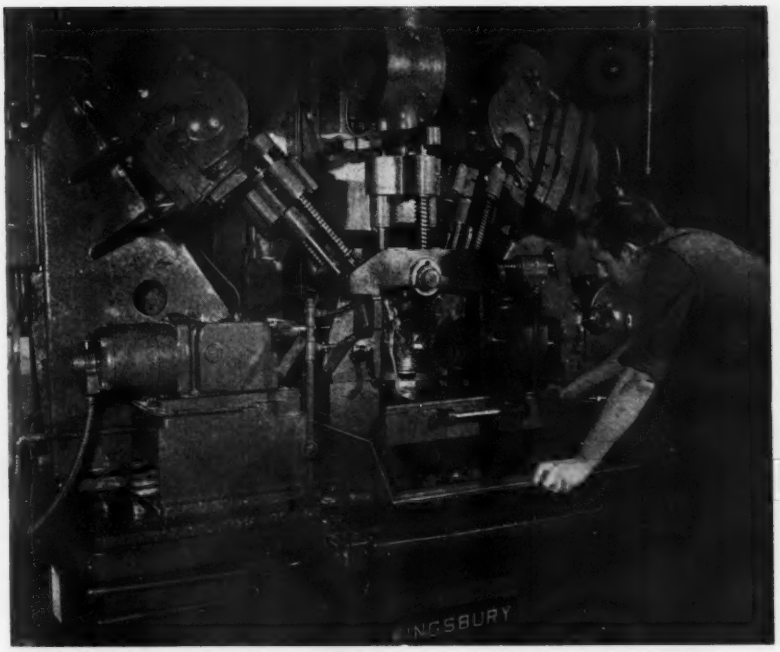
concerned only with those procedures created and adapted by the Vega Aircraft Corporation as distinguished from methods of producing Fortresses followed by the Boeing or Douglas companies. Although it is stated that all three companies follow identical methods in many instances and that all three rely upon subcontractors for a large number of items, each is governed by variations best adapted to its own working methods. The Vega system is based upon a pre-assembled component breakdown plan whereby components and panels are assembled on balconies and lowered to the main floor for joining on the final assembly lines. The consideration of Vega variations in Fortress manufacture begins in the wing department and is traced through the various departments that build parts of the plane to the completion of operations. *Aviation*, July, 1943, pages 136–138, 143–145, 318–321, 16 illus.

Producing Bomber Castings. J. A. Pates. Second part of an article describing the successful application of mechanization techniques to small- and medium-quantity production of light alloy aircraft castings, as demonstrated by the manufacturing methods of Kent Alloys Ltd. This installment covers the design and equipment of the mechanized foundry and gives a detailed account of the production of molds for a Stirling undercarriage gear box. The fettling shop has been laid out specially to accommodate the increased foundry output. *Aircraft Production* (London), July, 1943, pages 307–312, 17 illus.

"Liberators" by Consolidated Vultee. George S. Newman. A description of how the Fort Worth plant of Consolidated Vultee Aircraft Corporation carries out its production schedules for the manufacture of both Liberator bombers and Liberator Express cargo planes. Based upon a continuously moving assembly line and controlled material flow, the procedures are accelerated by the functional design of the plant's working space, which is laid out to provide a minimum of material travel. Because of the numerous parts required and the great variation in processing, the flow is by "lot" production to production centers, rather than by "line" or "mass" production from machine to machine.

The writer reviews the fabrication of parts from raw stock to finished components, pointing out the features that distinguish Consolidated Vultee methods. Included among these are the carriage conveyers and overhead monorail crane system used on the assembly line. *Aviation*, July, 1943, pages 146–151, 321, 323, 325, 15 illus.; "Separation Method Increases Liberator Nose Section Output," *Automotive and Aviation Industries*, July 15, 1943, pages 34, 35, 7 illus.

The Strategy of Production. F. W. Conant. The Vice-President of Douglas Aircraft in charge of manufacturing gives a brief outline of how the aircraft industry has responded to the war emergency. The transition of this industry from job-shop technique to modern quantity-production methods is described. It is emphasized that, great as the achievements of the industry have been, much still remains to be done and that peacetime air commerce will carry the aeronautical industry to a far higher destiny. *Aircraft Production* (Los Angeles), August, 1943, pages 16–18, 7 illus.



Machining of the combustion chamber, four boxes, and bottom flange of an aluminum cylinder head in the Buick Motor Division of General Motors. The eight stations use 22 carbide-tipped tools. (*See* page 87.)

Why American Planes Are the World's Best. J. H. Kindelberger. The President of North American Aviation explains how American fighter planes are kept better than the enemy's by a system of flexible tooling which permits constant changes and improvements without interrupting quantity production. Production methods and machine tools that have helped to make possible the quantity production of aircraft are described and illustrated. *Air Trails*, August, 1943, pages 15–17, 76, 9 illus.

Conveyorized Construction of Mosquito Fuselages by GM. R. Eric Crawford. An account of how General Motors of Canada builds fuselages for the de Havilland Mosquito. Details are given on the overhead monorail conveying system that forms the basis of the assembly methods. Special production procedures, equipment, and material are described. *Canadian Aviation*, July, 1943, pages 77, 78, 80, 82, 15 illus.

Sub-Zero Temperatures for Shrink Fits. Harold A. Knight. It is stated that probably the majority of the applications of extreme cold to metals today involves shrink fits. Since coefficients of expansion are known to the engineer, it takes no great skill to determine the proper temperatures and procedures. Sections of the article discuss the formula for shrinks, the advantages of shrink fitting as compared with press fitting, batch and continuous processing, fitting bronze bushings into pistons, shrinking a bearing race into a malleable housing, and assembling airplane landing struts. *Metals and Alloys*, July, 1943, pages 50–54, 4 illus.

"Liberators" by Ford. Chester S. Ricker. A survey of the production methods employed at Willow Run for the building of Liberator bombers. Detailed consideration is given to the principles followed in plant layout, the special fabrication processes, the application of Ford automotive methods to aircraft manufacture, and the system of coordinating the subassemblies on the final line. Data on special tools and equipment are included.

As described, the various stages of manufacture at Willow Run are divided into three distinct units: one in which raw material is converted into finished components suitable for subassemblies; a second where the fabricated parts are put together in subassemblies; and, last, the combination of subassemblies into completed bombers. *Aviation*, July, 1943, pages 152–158, 161, 362, 365, 366, 369, 370, 372–374, 22 illus.; "Ford Liberator Production," *Aircraft Production* (London), July, 1943, pages 347–349, 5 illus.

AC Engineers Use Automotive Methods to Speed Automatic Pilot Production. Joseph Geschelin. A description of the applications of

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quantity production methods to the manufacture of the Sperry automatic pilot as carried out by the AC Spark Plug Division of General Motors. The article explains how the ultra-sensitive mechanism of these instruments is being built in large quantities by straight-line production methods. *Automotive and Aviation Industries*, August 1, 1943, pages 34–37, 66, 70, 11 illus.

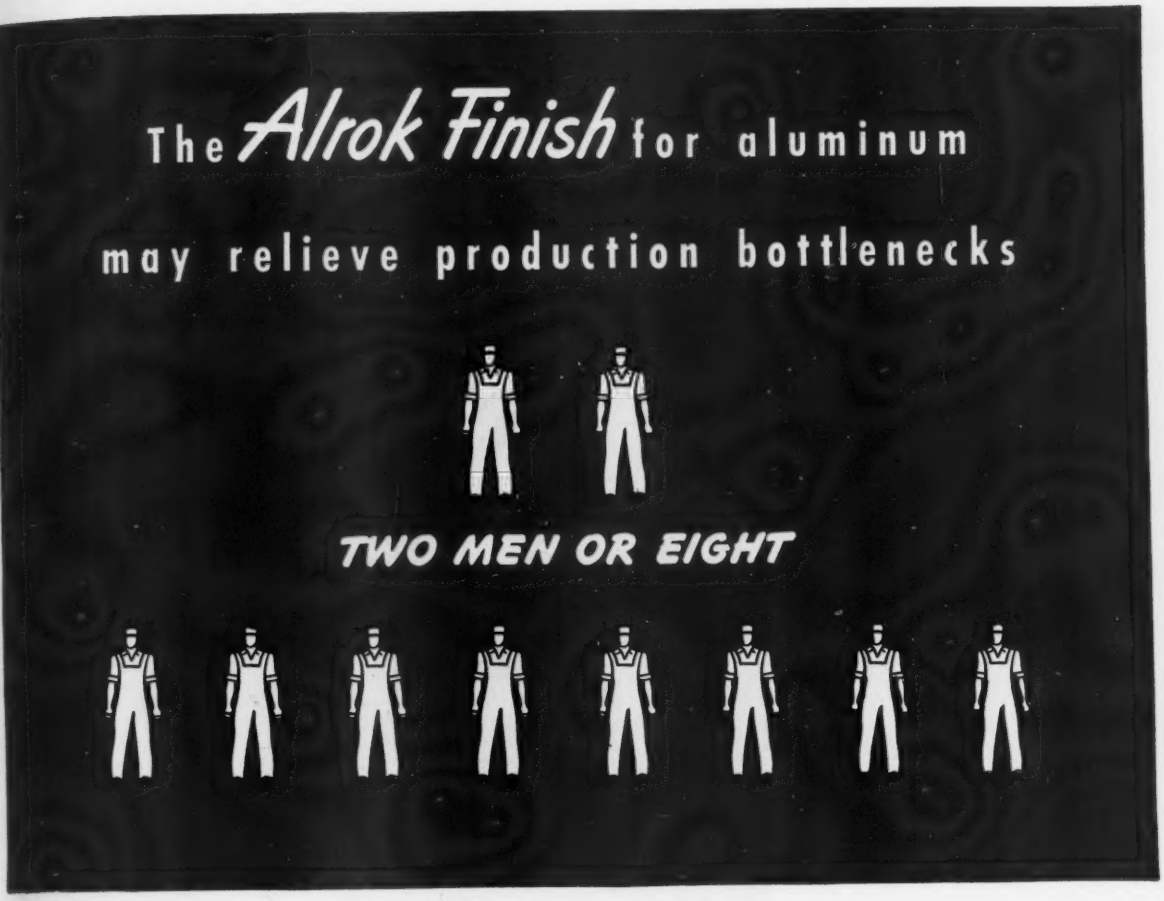
"Mustangs" by North American. Ralph H. Ruud. A component assembly technique calling for a minimum of "final" assembly marks the production methods of the North American Mustang. This detailed summary reviews the operations whereby equipment and accessories are virtually completely installed before the components are joined. Emphasis is placed upon the rapidity of the process, which is made possible by the design of the plane itself.

The activities of five major assembly lines are described. On these are assembled engine accessories, fuselage, fuselage tail cone, empennage, and wings. A number of minor assembly lines turn out landing gear, pilot housings, fuselage fire walls, etc. The flow of materials and parts, described in the article, is illustrated by a schematic diagram. *Aviation*, July, 1943, pages 162–167, 325, 17 illus.

Die Castings for the War Effort. Gustav Nyselius. A description of how the plant and equipment of the Mount Vernon Die Casting Corporation has been modified to permit the increased production of aluminum aircraft parts. Subjects discussed include cold-chamber machines for aluminum, die-cast alloys and parts, unit dies, and the types of machines and character of the work done in the plant. *Metals and Alloys*, July, 1943, pages 42–47, 9 illus.

"Avengers" by Eastern. Herbert Chase. How one of the plants of General Motors' aircraft division fabricates parts for and assembles Grumman Avenger airplanes. Many stations, each with a few specialized operations, are utilized in the underlying production plan, which calls for a maximum breakdown into subassemblies.

All the large subassemblies that enter into the main fuselage assembly are built in fixtures similar to, though not identical with, those employed by Grumman. Since the plant considered consists of alternate high and low bays which could not accommodate a large assembled plane, the main assembly line follows high bays, while the intervening bays are used for storage, the making and repairing of tools, and the assembly of small units and parts. Because of the height of the fuselage and the need for doing much work above wing level, high bays are equipped with fixed balconies along the edge of which the fuselage is advanced on a wheeled dolly at floor level.



Alcoa-research developed the Alrok* finish for use on aluminum surfaces that are to be painted. It has proved completely adequate for many parts. It is quite possible that this chemically-applied finish can be satisfactorily substituted in many places where the more expensive, time-consuming electrolytic finishes are now specified.

Note the savings possible where the Alrok finish is employed: In one plant, two men finish 800 pounds of small parts per hour by the Alrok process, and 100% inspection is not necessary. It takes eight men to finish the same quantity of parts by the electrolytic process.

Bear in mind that, for the use made of these parts, both jobs are equally acceptable. Only one fourth the number of men, and no electrical generators, are required for the former finishing job. The Alrok finish certainly deserves consideration for many parts on which the electrolytic finish is now specified.

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This Air Associates electric motor delivers 3 hp at 2,800 rpm . . . is specifically designed to operate a hydraulic pump used to feather and unfeather propellers. It is one of many lightweight, geared and direct drive types of electric motors for continuous or intermittent duty that Air Associates engineers and manufactures to Air Corps specifications . . . These motors operate hydraulic, fuel and anti-icer pumps; landing gear, flap and bomb door drives; gun turrets and other armament controls; tow target and anchor winch drives; fans, blowers and other types of motor driven aircraft devices . . . *Our present production schedules permit the acceptance of additional orders for delivery during the last quarter of 1943 through 1944.*

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Included in the illustrations is a diagrammatic drawing that traces the progression of parts and subassemblies from fabricating departments to final assembly. *Aviation*, July, 1943, pages 168–173, 326, 327, 329, 330, 333, 14 illus.

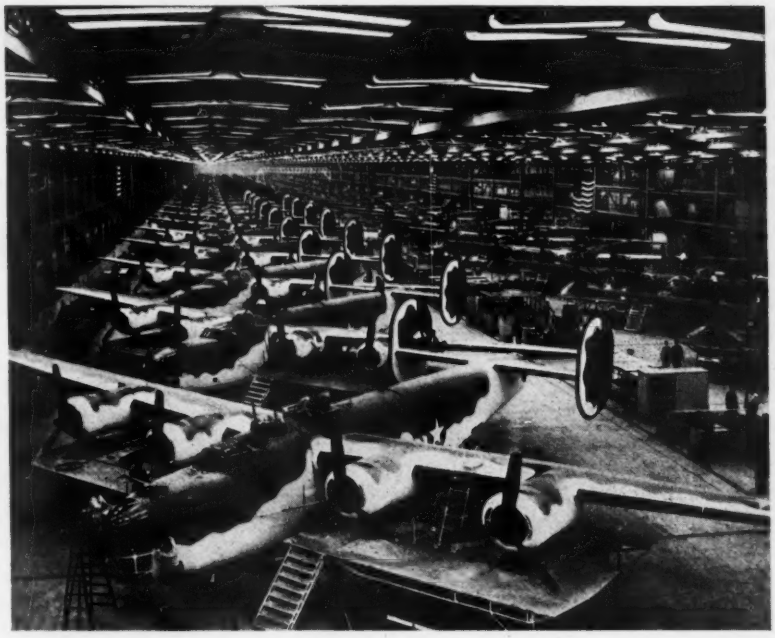
Thompson Aircraft Products Plant. Joseph Geschelin. An article describing the accomplishments of the Thompson Aircraft Products Company, whose new plant is stated to offer one of the finest examples of the quantity production of engine valves and aircraft-engine parts. Information on some of the types of valves produced is given. The sodium-cooled exhaust valve is stated to be responsible for a share of the credit for present-day high-performance engines. The article describes the equipment, production planning, and specialized techniques adopted to the manufacture of valves and other parts. *Automotive and Aviation Industries*, August 1, 1943, pages 20–25, 86, 88, 13 illus.

Plastic Working Magnesium Alloy Sheet. C. E. Lehnhardt. While the metallurgic development has contributed to a large extent to inducing confidence in the use of magnesium alloys in weight-saving applications, improved fabrication methods have kept pace with these developments.

This is the first of a series of articles discussing these fabricating methods as they apply to the forming of magnesium-alloy sheet metal parts. Plastic deformation and its advantages are described. Equipment and tools for fabrication of magnesium-alloy sheet are discussed in sections covering presses, brakes and bending rolls, blanking tools, and drawing dies. *Heat Treating and Forging*, July, 1943, pages 340–342, 4 illus.

Buick Practice in Machining P & W Cylinder Heads. Herbert Chase. An article on the Buick Motor Company's methods of machining and assembling cylinder heads for the Pratt & Whitney 14-cylinder engine. Stress is laid on those operations that differ in some respects from practices followed previously on the same part. Machining and hand procedures, finishing, and testing are described. However, not all operations are included; nor are all details released. *Aviation*, July, 1943, pages 174–176, 354, 357, 358, 361, 8 illus.

A Few "Home Truths" About the Aircraft Parts Business. A. Weatherstone. Some observations on the problems of the aircraft parts business, with particular regard to Canada. The major factors that affect the estimating of the types and quantities of spare parts to be manufactured and carried in stock are outlined. Describing the specialization of design and production required for airplane components, the writer's conclusion is that, for the Canadian aircraft program, the manufacture of parts in small quantities is inevitable. He states that the whole problem resolves itself into making parts in quantities that cannot be called steady production but the processing of an enormous quantity of items in job lots. *Canadian Aviation*, July, 1943, pages 84, 86.



A partial view of the double aircraft assembly line in Consolidated Vultee's Fort Worth plant. In the foreground are Liberator bombers and to the rear are C-87 Liberator Express transports in various assembly stages. The second line is composed of B-24 Liberator bombers in final assembly stages.

Airplane Cost Estimating. John M. Stinson. An article written for the purpose of giving the weight engineer a better understanding of how the material he originates is put into use. Airplane cost estimating is divided into four separate types of work, which are described as production cost estimating for cost purposes; the estimating of labor and material involved in fabricating a part or an assembly by the use of blueprints for the purpose of establishing a spare parts selling price; the estimating of costs of changes in airplanes; and the estimating of complete airplane contract costs. Each class of estimating is discussed. It is stated that airplane cost estimating is not guessing but the ordered application of experience and judgment. *Weight Engineering*, Spring, 1943, pages 12, 27.

Streamlined Materials Handling Keeps Parts Moving. Arthur J. Brennan. A description is given of how advanced methods of handling materials, similar to those used in automotive manufacture, have been applied to aircraft work at the Rochester Products Division of General Motors. This plant has been converted to the manufacture of aircraft electric starters, generators, alternators, and controls. Storage facilities, monorail conveyers, and conveyerized benches, which have proved their utility in speeding the production of aircraft accessories, are discussed. *Wings*, July, 1943, 565–569, 9 illus.

"Fortresses" by Boeing. A detailed examination of the multiline production system by which the Boeing Aircraft Company builds Flying Fortresses. The procedures related are based upon a plan for precompletion of all major portions of the aircraft before these assemblies reach the final assembly stage. It is shown how the functional plant layout, the full use of all existing facilities, and the assembly methods contribute to this plan.

The chief ideas guiding the Boeing assembly plan for Flying Fortresses are outlined as follows: to delay final assembly until major assemblies nearly reach the door; to provide all interior installations in the various assemblies before they reach this point; to compress more production in the factory by completing major assemblies as separate units; and, farther back in the factory, to feed the major assembly operations with precompleted subassemblies. For the major assembly, five main divisions are described: wing inner sections, rear fuselage, forward fuselage, area where the two are joined, and final assembly of all parts just in front of the door. A chart illustrates the fabrication plan. *Aviation*, July, 1943, pages 124–129, 309–311, 19 illus.

Bell's Production Methods and Their Advantages. O. L. Woodson. A detailed analysis of the production methods used by Bell Aircraft, by that company's Vice-President and Assistant General Manager. Three fundamental procedures are reported

Increased Operating Efficiency Through Automatic Engine Control

Air combat tacticians say, "Leave the pilot free for fighting." Freedom from the constant manual operation of engine controls, and safer, more efficient engine operation is the purpose of the Simmonds-Hobson Automatic Engine Controls.

This outstanding engineering development constitutes an important step toward relieving the pilot of routine. By automatic control of such essentials as manifold pressure and mixture, it acts as a third hand for the pilot, giving engine protection and longer life. The sensitive unit maintains a selected setting through varied maneuvers and altitudes, thus eliminating the manual operation of cockpit control and assuring more efficient performance.

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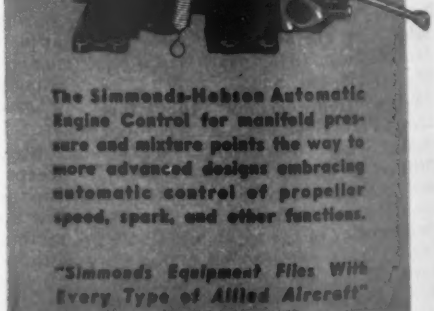

The Simmonds-Hobson Automatic Engine Control for manifold pressure and mixture points the way to more advanced designs embracing automatic control of propeller speed, spark, and other functions.

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to form the basis of the system. One is "coordinated lofting," which eliminates completely the use of drawings anywhere in the plant except in the lofting department itself and in the final inspection room. The second is substituting mechanical handling of material for manual handling wherever possible, and the third is routing the flow of materials and parts in one direction until they become the finished airplane. The article also shows how the equipment and functional layout of the plant contributes to the facilitation of these procedures. *Aero Digest*, July, 1943, pages 147, 149, 154, 157, 268, 350, 353, 357, 10 illus.

From Lofts to Dies to Planes. Herbert Chase. The Bell Aircraft Corporation has developed an inexpensive method of making blanking and piercing dies. The method is credited with having speeded the production and assembly of sheet metal air-frame parts. How the dies are made and the application of strippers are described. It is shown that highly skilled toolmakers are not required for this kind of work. *Wings*, July, 1943, pages 573–576, 8 illus.

Propellers

Automatic Synchronizer Controls Engine Speed. Brief information on the purpose and operation of the automatic engine speed synchronizer, developed by the Curtiss-Wright Propeller Division. This device operates by adjusting a single control knob for obtaining the desired engine speed of a multiengined plane and at the same time automatically synchronizing all the engines at this speed. Claimed to be simpler than the standard constant-speed governor system, the knob control unit has reduced the amount of time required to attain synchronization. *Aero Digest*, July, 1943, pages 207, 2 illus.

The Importance of Feathering Airscrews. L. B. Greensted. The basic principles of feathering propellers are explained and their advantages are demonstrated. With particular reference to those manufactured by Rotol Airscrews Ltd., the characteristics of electrically and hydraulically operated feathering propellers are described.

In addition to recommending a sequence for normal operation, the article advises on emergency operation. The normal procedure is outlined as follows: (1) close throttle; (2) move speed control lever to feathering position; (3) switch off ignition; (4) press feathering button. Notes are included also on restarting an engine after the propeller has been feathered, gradual unfeathering, and the use of the booster pump in feathering and unfeathering of the hydraulically operated propeller. *Commercial Aviation*, June, 1943, pages 40–42, 5 illus.

Transparent plastic shields guard propeller blades from air drafts during delicate final grinding and balancing operations. (*See* page 139.)

Radio

Determination of Directional Characteristics of Aircraft Antennas. Edward Lovick, Jr. Description of a method for predetermining antenna characteristics and locations by using a scale or wind-tunnel model. Based on the theory that if the wave length is reduced by some factor the frequency must be increased by the same factor, the writer shows how a scaled-down model can be used for determining field-strength patterns if the frequency used to excite the model antenna is increased by the scale factor. Two factors are judged to be of paramount importance for obtaining reliable results: first, the test model must be constructed accurately to scale; and, second, the electrical resistance of the reflecting surfaces must be the same as that of the prototype surfaces.

In addition to a scale model, the other pieces of equipment required are a single generator that can be set accurately to the required frequencies, feeders and tuning apparatus, a field-strength measuring set, and a means of suspending the model some distance above the earth. An indication of the nature of the problems involved in the study of aircraft antennas is given. *Aero Digest*, July, 1943, pages 259, 260, 3 illus.

Radio in the Air Forces. Franklin H. Stevenson. Stressing the importance of radio to military aviation, this article depicts the development of radio from its first Army air test 31 years ago to its present utilization. An account of a typical bombing mission from England to Germany illustrates the latter.

Part of the article is devoted to a description of the "Gibson Girl," a small, fixed wave-length, manually operated radio. This device sends an automatic S O S for the rescue of airmen who are adrift at sea. *Skyways*, August, 1943, pages 36, 37, 60, 82, 7 illus.

Stress Analysis

Compilation of Weight Data for Structural Analysis. John C. Reams. It is emphasized that the weight of the completed airplane is vital not only to performance but also to its utility to the customers. The accuracy with which external, internal, and allowable loads can be determined depends to a great extent on the accuracy with which the shear and bending moments are determined. This, in turn, is dependent on the correctness with which the weight and disposition of the components are estimated or known. The writer discusses the preparation of shear diagrams, the compilation of data, short-cut methods for estimating sturctural shear and bending moments. *Weight Engineering*, Spring, 1943, pages 34–37, 7 illus.

Testing

Airscrews. "Witness." The ninth installment of "Notes from a Test Pilot's Diary" deals with the testing of airplane propellers. Ground-feathering tests are stressed as an essential preliminary to air feathering. The writer recommends a safeguard for general application to air-feathering tests. This is to restrict the air speed so that even if the propeller does go into fine pitch the revolutions cannot exceed the normal maximum with the throttle all the way back. He states that the critical air speed will vary with height and can easily be determined by throttling back at cruising speed, putting the speed-control lever to the maximum-revolutions position, and noting the air speed at which the revolutions begin to fall, thereby indicating that the blades have reached the fine-pitch stops. The article also demonstrates why the checking of ignition is best done at power below the governing speed, rather than at full power, on the ground. *Flight*, June 3, 1943, page 575.

Oil Pressure. "Witness." The eleventh installment of "Notes from a Test Pilot's Diary" is concerned with the effects of altitude on oil systems and the consideration of this problem in test flying. Explaining why test-bed readings are higher than when the engine is installed in an airplane, the writer states that the most simple effect of altitude is the lowering of the oil pressure pump's working efficiency due to the reduced pressure of the air. Another important result that he discusses is the increased frothing tendency of hot oil when there is not sufficient pressure to hold in the emulsified air. The causes of aeration are reported, and the two most common methods of restoring oil pressure are described—screw up the pressure release valve and make a rigid inspection of the suction line for possible air leaks at the joints. *Flight*, July 1, 1943, page 8.

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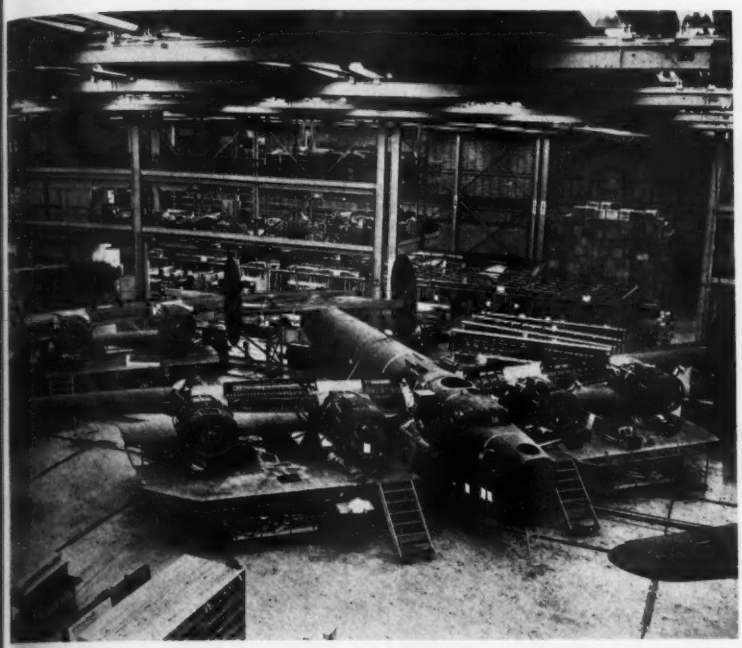

Liberator bombers move along the final assembly line at a 45° angle in a Consolidated Vultee plant. Note the accessibility of material to the working stations. (*See* page 83.)

Testing Equipment

Motor Fuel Supply System for Engine Test Rooms. Arthur Fox Holler. An article on the problems involved in the design and installation of a fuel-supply system to provide for a 50 per cent increase in the number of engine-testing rooms at a large aircraft-engine plant begins with an outline of the conditions to be met. The capacity had to be sufficient to maintain full operations continuously, although underground storage space was limited and the new facilities had to be completely installed without interrupting operations in the existing test rooms.

The equipment selected is outlined, as well as the safety precautions that were observed, and a description is given of the installation and operation of the new system. Several difficulties were encountered in the operation of the equipment in the beginning, but the remedies described overcame the troubles and the system has been entirely satisfactory since that time. *Aero Digest*, July, 1943, pages 209, 210, 281, 2 illus.

Tools and Equipment

Selection of an Adequate Scale Installation for Airplane Weighing. L. R. Hackney. Salient features of several recent scale installations are reviewed and an arrangement is described in which the writer attempts to combine their most outstanding advantages. Airplane-scale design is discussed in sections covering the allowance for larger airplanes, types of weighing equipment, permanent aircraft weighing scales, and portable aircraft weighing scales. A table giving the specifications of different models of aircraft scales is included. *Weight Engineering*, Spring, 1943, pages 40–45, 8 illus.

Training

Crash and Die—Live to Fly. Capt. A. Roy Brown. An analysis of the accidents in the flying training of the Royal Canadian Air Force, together with an account of what is being done to limit this type of casualty. Figures are given to show the improvement in the record of R.C.A.F. training accidents, and the role played by the Accident Investigation Branch in helping to reduce the number of these accidents is described. The following are among the means that are being used to lower the accident rate: improvement of training procedures; the constant check on flying schools to ascertain that instruction and work is up to standard; and the circulation of information. Urging the cooperation of all groups, the writer stresses the importance of getting aircrews to discontinue low flying. *Canadian Aviation*, July, 1943, pages 37–39, 96, 98, 6 illus.

Air Gunner Training. The curriculum of a British air-gunnery school is described. In addition to data on the specialized training—which includes firing practice in air and on range—the article contains information on the equipment with which firing conditions in the air are duplicated, for practice purposes, on the ground. Besides instruction in gunnery and aircraft recognition, the student receives lectures on first aid, high-altitude flying, dinghy drill, air-sea rescue, and the use of pyrotechnic signals. Cadets come under two classifications: full-time air gunners, and others (such as flight engineers or wireless operators) who take a short course to enable them to handle a power-operated turret in case of emergency. *Flight*, June 3, 1943, pages 577–580, 10 illus.

'The Automotive Industry's Training of Aircraft Engine Mechanics. E. L. Warner, Jr. The article describes how four automobile manufacturers now engaged in the production of aircraft engines have converted part of their sales and factory training personnel to the instruction of Army Air Forces' recruits. Training activities at the Buick, Chevrolet, Ford, and Packard plants are outlined. *Automotive and Aviation Industries*. July 15, 1943, pages 17, 18, 98, 100, 4 illus.

What Is This Thing Called Coordination? Lt. Comdr. John G. Jenkins. Based upon the interpretation of coordination in terms of reaction rather than muscular ability, a flight training technique is advised for teaching students coordination. Coordination is defined as the ability to recognize the need for certain actions early enough to permit simple movements. Clear demonstration and constant repetition, aided by slow-flying practice at safe altitudes, are suggested as the best means of achieving it. To help a student coordinate, it is stated, the instructor must teach him what to look for, where to look for it, and when to begin to look for it. *Air Facts*, August, 1943, pages 36–41.

'Special Devices.' Stewart Johnson. A survey of the ground equipment used by the U.S. Navy to accelerate the training of its flying cadets. This equipment simulates flight conditions so that students can get a great deal of their instruction in surroundings identical with those they will find in the air. Among the devices described are the "navigator's cart," the dummy instrument panel, "gun turrets" from which hits are registered against "targets" on a screen, the Link Trainer, and several aids to recognition training. An account is given also of how a combination of red and green plastics is used to simulate night flying conditions. The article includes some biographic data on Comdr. Luis de Florez, head of the Special Devices Section of the Bureau of Aeronautics. *Flying*, August, 1943, pages 24–26, 168, 172, 6 illus.

Sperry School. Some data are presented on the Sperry School in England. Jointly run by the Sperry com-

pany and the Technical Training Command of the R.A.F., this school was established to train civilian and military personnel in the maintenance and repair of automatic pilots, bombsights, and other Sperry instruments. The article briefly traces stages in the gyropilot course and lists some of the equipment that is used in the work. *Flight*, July 1, 1943, pages 18, 19, 7 illus.; "The Upkeep of 'George,'" *The Aeroplane*, July 2, 1943, pages 26, 27, 6 illus.

Split Second Recognition . . . A New Allied Weapon. The principles of the Renshaw System of Recognition, its development and the methods by which it is taught, are described. Created by a psychologist and adopted by both the Navy's Bureau of Aeronautics and the Army Air Forces, this system is claimed to effect recognition of aircraft, ships, and tanks in times down to one one-hundredth of a second. Its three fundamental objectives are outlined as follows: (1) to improve general vision effectiveness; (2) to train the observer to estimate accurately the number of objects in the field of vision; and (3) to train the observer to recognize instantly airplanes, surface vessels, and armored land vehicles.

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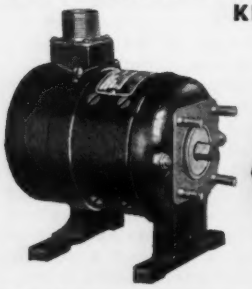

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FRACTIONAL HORSEPOWER SPECIAL APPLICATION MOTORS

Details are given of the training course as it is conducted at an Army school where Air Forces, Infantry, and Coast Artillery personnel are trained at Renshaw instructors. Concentrated eye training is supplemented by instruction in the characteristics and potentialities of the craft the students will be called upon to identify. The course runs 36 hours per week for a period of 4 weeks. *Aviation*, July, 1943, pages 119, 382, 385, 1 illus.

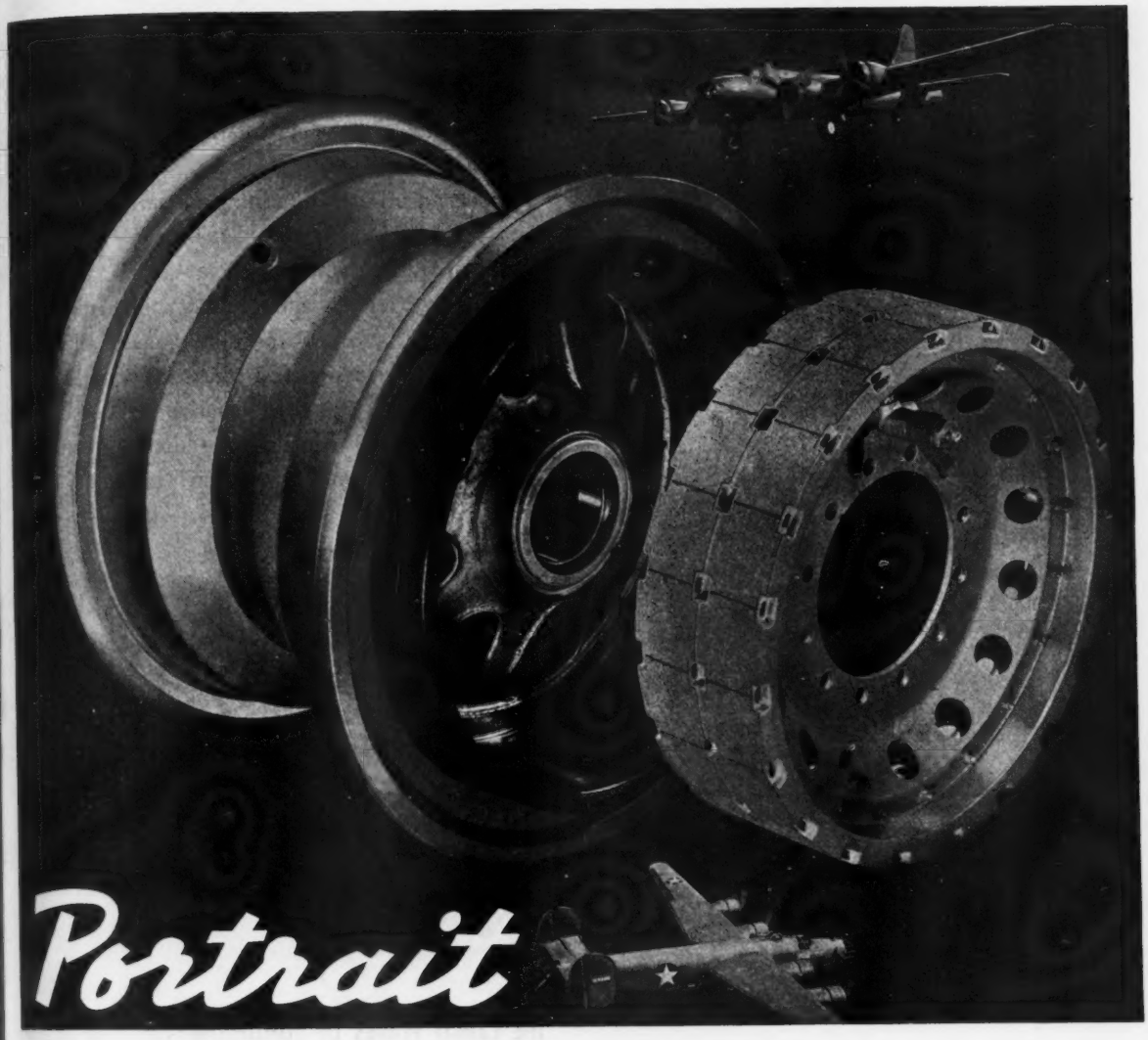
Intensive Schooling Provides Operators and Supervisors in Quantity. Otis F. Presbrey. Changes in the employee training program of the Sperry Gyroscope Company necessitated by the rapid expansion of manufacturing facilities are described. The writer explains how production-line techniques adapted to teaching have made it possible to provide 300 trainees a week. Increasing requirements for high-speed instruction have necessitated the inauguration of an intensive 3- to 4-week course in which the new employee is fully instructed in the operation of the particular type of machine he will operate when assigned to production. A special course for prospective first-line supervisors has been instituted. *Wings*, July, 1943, pages 570–572, 3 illus.

The Will to Fly. E. C. Bailly. Some observations on what constitutes the will to fly and how an instructor can develop this will in his students. The acceptance of flying as a challenge that must be met is considered a more enduring motive for becoming a pilot than the glamour, prestige, or promise of a profession that accompany the ability to pilot a plane. Indicating the instructor's responsibility in fortifying this attitude, ways are suggested by which he can instill confidence and abolish fear in the student. *Air Facts*, August, 1943, pages 47–51.

Caring for Every Mechanical Need of the Army's Air Fleet. One of the principal components of the Air Service Command, which is referred to as the largest command of the nine in the U.S. Army Air Forces, is the air depot that stocks parts and repairs and maintains Army aircraft. The article is devoted to a description of the San Bernardino Air Depot, which is one of the eleven major control depots of the Air Service Command. The depot's system of processing, the training program, and its other activities are included. *United States Air Services*, July, 1943, pages 20, 22, 1 illus.

Warfare

Flying Under the Cross of Lorraine. Col. Brevete Charles Luguet. An article on the Fighting French Air Force, by the head of the Aviation Section of the Fighting French Military Mission in Washington, D.C. Anecdotes of how various members of the personnel escaped from the Nazis to join the Force are related, and the training, equipment, and battle rec-



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ords of the squadrons are outlined. The different fronts on which the Fighting French Air Force has fought against the Axis are also designated. *Skyways*, August, 1943, pages 26, 27, 66, 68, 7 illus.

The Greeks Are in the Air Again. Henry Baerlein. Some notes upon the independent units within the Middle East Command of the Royal Air Force maintained by the Greek Air Force. They touch upon the source of personnel, training, spirit, and performance record of these groups. *The Aeroplane*, June 4, 1943, page 644, 4 illus.

Why Bomb Industry and not Agriculture? Robert H. Alexander. The writer discusses the value and feasibility of reducing Germany's food supply by aerial attacks on agricultural regions. He suggests that such attacks could be carried out by dispersed, low-flying bombers that would carry small bombs and cross the German border at a number of points. It is pointed out that, since the nature of the bombers' job would keep them away from fortified centers of population and industry, there would be almost no antiaircraft fire to combat and little adequate fire-fighting equipment to prevent the spread of damage. In addition to wrecking agricultural activities, the writer predicts that this type of raid would be extremely disruptive to German morale. *Air Facts*, August, 1943, pages 20–22.

Welding

Second Interim Report of the R.52 Sub-Committee on the Spot Welding of Light Alloys. Gordon H. Sutton and H. E. Dixon. The first part of this report describes investigations undertaken: (a) to determine the cause of the variation in static shear strength and to define the conditions for the production of welds of consistent and predictable strength; (b) to provide additional information on the strength properties of single spot welds and to compare these properties with those of riveted joints; and (c) to determine the stress distribution in spot-welded joints.

The first part of the report also deals with the results of investigations of several problems related to variations in shear strength. These are treated under headings of: (1) contact resistance, including the static contact resistance of differently prepared surfaces and change of resistance during welding; (2) tests on welds made with high electrode pressures; (3) pickling and surface treatment, including fatigue tests on parent metals and tests on spot welds in surface-treated metals; (4) torsion and compression tests on single spot welds. Conclusions resulting from these tests are summarized, and the article then takes up the properties of spot welds and the stress distribution in spot-welded joints. The second part gives miscellaneous comments on the subject. Numerous tables and charts clarify the text.

New external bomb racks for the B-17 boost its bomb capacity to a peak of 10 tons. This is an alternate supplementary bomb-carrying arrangement to permit unusually heavy loads for limited range operations.

The Institute of Welding Quarterly Transactions, April, 1943, pages 49–67, 17 illus.

Spot-Welding. T. M. Roberts. Notes prepared from a general engineering standpoint give the results of many years of study of the advantages of light alloy spot welding in the manufacture of all-metal stressed-skin aircraft. They indicate the development of the condenser-type spot-welding machine in the organization of the Bristol Aeroplane Company, Ltd. The article reviews briefly the types of welding machines that were available in 1940 and gives a detailed description of the condenser-type machine and its investigation undertaken by the engineers of the company in association with representatives of Phillips Industrial, Ltd. Information is given on an examination of American practice. One important feature of the investigation was the establishment of the opinion that the condenser type is speedier than others investigated. Among the other features discussed are electrode design, refrigeration of electrodes, surface preparation, and analysis of etching solutions. Various processes of etching are compared, and other subjects treated are the strength of the welds, methods of supporting the work and other production aids, and the maintenance of the machines. *Aircraft Production* (London), July, 1943, pages 338–343, 9 illus.

Miscellaneous

Automotive News 1943 Almanac. The tenth annual review and reference edition is featured by a record of the contributions of the automotive industries to the nation's war effort. Since many of the automotive companies are producing aeronautical equipment, from complete airplanes and engines to parts, subassemblies, and accessories, the pages contain a large amount of information and illustrations showing the manufacture of such aircraft and equipment. The war activities of each company and division are described in separate items covering the particular kind of work performed, with many illustrations of the finished products and of processes used in their production.

Another section of the periodical contains extensive tabulations of statistics and charts showing production figures and other data bearing upon the automotive industries and related lines of business. Portraits and brief biographic sketches of executives and other individuals in the industry are arranged in alphabetical order.

A directory titled *Who's Who Today in the Automotive Industry* contains a roster of the manufacturers of passenger cars, trucks, parts and accessories, products made, officers, Detroit representatives, and advertising agents. *Automotive News*, August, 1943, 170 pages.

The Aircraft Industry and the College Graduate. Howard W. Barlow. It is stated that in order to supply the needs for aircraft designers, planners, supervisors, and production personnel, there must be an expansion of aeronautical engineering training. If these needs are to be met by the colleges, many well-worn existing arrangements must be changed. The establishment of more 5- and 6-year courses for the advanced professional brackets must also be instituted. The broader aspects of aeronautical engineering should be recognized immediately by the industry, as well as by the educational institutions, to the end that closer cooperation between industry and the educational institutions may be mutually encouraged. It is incumbent upon the colleges to encourage aeronautical engineering training now so that America will be in a position of leadership in the post-war development of aviation. *Weight Engineering*, Spring, 1943, pages 9, 10, 1 illus.

Cessna's new cargo plane, the "Loadmaster," has been designed as a military "front line dispatcher." Built to operate from small fields close behind the battle lines, it is powered by two dependable Pratt & Whitney Wasp engines.

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Government Publications

Army Air Forces

This Is Our Battle Plan. Major Gen. Claire L. Chennault. The Commanding General of the 14th Air Force writes a part of the talk that he gives to new pilots assigned to his unit in China. He tells them how to find their way around in the air over China, warns them about weather changes, gives advice about the use of the radio reporting network, and instructs them in their future work in combat. Emphasis is placed on the equipment and skill possessed by the Japanese airmen, their tactical plans and the methods they employ, and on the points of superiority of the American equipment and training.

He praises the Chinese pilots with whom the Americans work and advises his men to be guided by the experience and the spirit of the Chinese. *Air Force*, August, 1943.

"Flight Strips" for War and Peace. Col. Stedman Shunway Hanks. The program for building and using flight strips is described, with the statement that the success achieved has surpassed the expectations of the sponsors of the project. The wartime utility of flight strips for tactical operations, for dispersal of military aircraft, for antisubmarine work, in aircraft ferrying, and in air transport is discussed, in addition to the use of the strips as emergency fields. Instances are recalled wherein the strips have been instrumental in preventing accidents.

Details are given about the strips built along the Alcan Highway in Alaska and Canada and the ways in which they have served in air operations in that territory. How the flight strips are being used as supplementary facilities for established airfields and how they are coordinated with air transport facilities are covered. Considerations that determine the location of the strips are outlined, and estimates are given on comparative costs of strips and airfields. The third major point in the article concerns flight strips in connection with present and future international air traffic.

Credit is given to the various departments in the United States Government which have participated in the program. *Air Force*, August, 1943.

Your Friend Airways Traffic Control. Lt. Col. George C. Price. The Chief of Staff of the Flight Control Command writes about the Airways Traffic Control organization and how it works, giving a description of some of the facts pilots must keep in mind while on an airways flight. He traces the progress of a hypothetic flight from Chicago to Patterson Field, Ohio, telling how the flight is routed and what takes place along the line. The actions taken at various control centers and range stations and the reasons for such actions are explained, along with the functions of the operators at these stations and their responsibilities.

It is stated that the network of skyways and navigational aids is the best that can be found anywhere in the world. Credit is given to the Civil Aeronautics Authority for the successful installation and operation of this system. *Air Force*, August, 1943.

How to Keep Well in the Indian Theatre. Brig. Gen. David N. W. Grant. In another of a series of articles on health conditions in the various theaters of war operations, the Air Surgeon writes about conditions encountered by American airmen in India and the diseases to which they are subjected. Malaria, dysentery, the fungus diseases, venereal diseases, and snake bites are among the grave military medical problems that are met throughout the country. The incidence and treatment of each of these are discussed, and advice is given concerning the steps to be taken by individuals to prevent the contraction of diseases. Various animals and insects that are dangerous to man are mentioned, along with information on how to avoid injuries inflicted by them and what to do in the matter of emergency treatment. *Air Force*, August, 1943.

Depth Perception Simplified. Lt. Col. M. E. Parks. An advance over the stereoscopic principle of making three-dimensional pictures, called Vectographs, and their use in military air operations are described. The new feature of the Vectograph is stated to be that it provides an easy way for nonexperts in aerial photography to benefit from three-dimensional views and permits quantity reproduction of such pictures for new and important uses.

The method is compared with the stereoscope and its advantages are shown. Its principles of operation are explained, and instructions are given for making and using Vectographs.

The principal military value is summarized as follows: briefing combat teams, such as bomber crews, air-support groups, parachute teams, and various other air, land, and sea units; staff work, for tactical planning; intelligence reports; and for training large classes of air and ground personnel. *Air Force*, August, 1943.

Production Line Maintenance. Lt. Col. Charles E. Cox. The system known as production line maintenance is credited as one of the major factors in the air crew training record made by the Army Air Forces. It is stated that the method was originated in the Fall of 1942 by the West Coast Training Center and is now being adapted for use at all advanced and specialized flying schools in the Flying Training Command.

With the aid of a chart, its operation is explained in considerable detail. Contrasts are shown with the methods formerly followed, and the advantages obtained are summarized as follows: trains better mechanics in a shorter time; greatly reduces man-hours for inspection and engine change; prolongs airplane life and increases time between overhauls; releases more airplanes for flying; reduces number of planes grounded during day for small defects; anticipates parts needed in advance; gives planes better appearance; and maintains airplanes better. *Air Force*, August, 1943.

Cargo from the Sky. Theodore A. Berchtold. The production and use of cargo parachutes are described, it being stated that they were developed in the Equipment Laboratory at Wright Field and are being used in increasing proportions in areas where dropping supplies from the skies is the quickest and most practical method of solving the supply problem.

The different sizes and types of parachutes and how they are employed are described. Developments indicated for the future include parachutes for dropping cargo from greater altitudes than are now practical, paper para-

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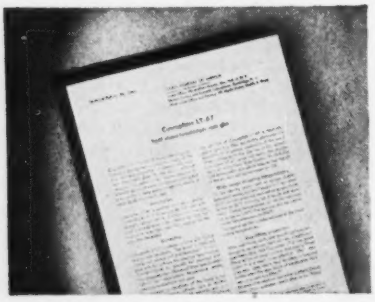

JUST PRINTED—new Technical Bulletin 104a—Eight pages, complete details on mixing, spreading, pressing, testing of Cascophen LT-67. Keep up to date. Send for your copy. Address: Casein Company of America, Dept. AR-9, 350 Madison Avenue, New York 17, N. Y.

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chutes, pneumatic parachutes, and the ultimate weight loads to be attained. *Air Force*, August, 1943.

National Advisory Committee for Aeronautics

Experimental Investigation of Impact in Landing on Water. R. L. Kreps. Translation of Report No. 438 of the Central Aero-Hydrodynamical Institute, Moscow, 1939. The object of the paper is to show how far test results agree with the available approximate computation methods for determining the impact forces in bringing aircraft to rest on water, to investigate in greater detail the physical nature of impact on water, and to perfect an experimental method of studying the phenomenon.

For the analysis of the obtained experimental results the fundamental impact computation formulas are given. The experimental procedure is described and the accuracy attained is indicated. The tests were conducted on a number of different shapes: a disc, a disc with aperture, a wedge or V shape, and a wedge with slots.

The results of all these tests showed a deviation of the test curves of the ratio of velocities before and after impact from the corresponding theoretic results computed by the formulas of Wagner. The reasons for these deviations is explained by the failure to take into account in the equation of motion of the body during impact of the weight of the body and the resistance of the water.

The tests on the V shapes indicated a considerable decrease in the discontinuous velocity change during impact with increasing wedge angle.

From the theoretic investigations, it follows that the presence of even a small slot on the surface of the body sharply reduces the magnitude of the associated mass on impact. The dropping tests conducted on a slotted V shape and on a disc with aperture did not show, for these bodies, any corresponding decrease in the impact velocity change. The experimental determination, however, of the associated mass of the various bodies with openings gave, in complete agreement with theory, a considerable decrease in the associated mass of these bodies as compared with similar bodies without openings. An analysis of these facts is given which leads to the conclusions that in a number of cases the discontinuous velocity change on impact is not with sufficient accuracy determined by the usually accepted formula. It may be assumed that by taking into account the resistance of the water, the agreement of the experimental results with theory would be considerably improved. *N.A.C.A. T.M. No. 1046*, August, 1943.

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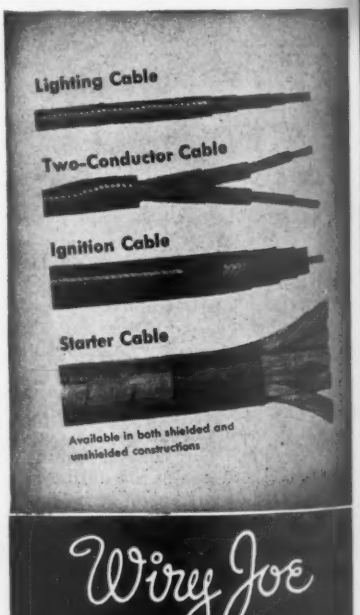

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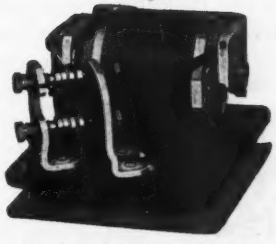
Write for Series 10 bulletin for A.C., or Series 5 bulletin for D.C. applications.



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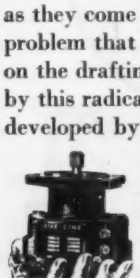

With a wide web like a tank tread, this new type of landing gear provides a much greater landing area than comparable tire and wheel equipment. Both vertical and directional impact is dissipated by the large *Levered-Suspension* shock absorber holding the track mechanism, and a second set of shock absorbers within the mechanism. Flight tested at Dayton, it has set down the test ship safely at speeds up to 120 miles per hour on rough terrain, sand and soft ground. Retractable, it will weigh less than the multiple tires it will replace . . . and hundred tons-plus planes will land and take off anywhere in safety without special runways—with the HUB-FIRESTONE track landing gear.

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Civil Aeronautics Administration

Aviation—Nation's Largest Industry. C. I. Stanton. The Civil Aeronautics Administrator states that the aeronautical industry is by far the largest industry in the country at present, showing that its production has increased from a total value of $280,000,000 in 1939 to an estimated aggregate of $20,100,000,000 for 1943, and that the 1944 goal has been set at a tonnage increase of 55 per cent over that for 1943. These figures are analyzed in terms of employment, training, and utilization of the manufacturing capacity that has been provided. It is indicated that many thousands of the trained pilots, navigators, engineers, and other aircraft personnel will want to continue in the aeronautical industries after the war if it is made possible for them to do so. In this connection, it will be necessary to plan actively for the required airports, airways, and other facilities. Figures are given on recent airport development and the growth of the airways. It is forecast that the greatest boom will come in the field of private flying for business and pleasure in which the family plane will have a prominent part. Future uses for helicopters and airplanes are explored, and the field for aviation in the general scheme of transportation is outlined.

The opinion is expressed that aircraft will perform vital functions by supplementing, not supplanting, surface transportation and that the future of the airplane is practically boundless. *Civil Aeronautics Journal*, July 15, 1943.

Navy Department

The July supplement to the index of Army-Navy Aeronautical Standards contains alphabetical lists of Army-Navy aeronautical specifications, Army-Navy aeronautical standards drawings, and Army-Navy aeronautical bulletins, revised to July 1, 1943. It gives the title of each item, the current number, and the Army or Navy numbers superseded.

In addition to the index, 26 new and revised Army-Navy standards sheets have been issued on various items of equipment, designated by AN numbers, as well as 5 new and revised Army-Navy aeronautical design standards sheets, designated by AND numbers, and two Naval Aircraft Factory standards sheets on fuel and oil-tank filler units and antenna fairleads. *Working Committee of the Aeronautical Board, Bureau of Aeronautics.*

Air Registration Board of Great Britain

Notes on the Regulations Governing the Airworthiness of Civil Aircraft.

The legal requirements concerning the registration, classification, and operation of civil aircraft in Great Britain and Northern Ireland are given in a booklet of 48 pages. It traces the origin and authority of the Statutory Rules and Orders, Air Navigation Directions, and the Regulations governing civil aircraft operation, and explains the steps that must be taken to comply with these regulations.

Among the subjects covered are registration and classification to aircraft, issuance and renewal of certificates of airworthiness, modifications to aircraft, fittings, instruments and equipment, and approval of air crews. *A. R. B. Handbook No. 1*, 2*s.* 6*d.*

The Duties of a Licensed Aircraft Engineer. A booklet of 28 pages gives information on the requirements for licenses and the duties of licensed aircraft engineers in Great Britain, with particulars of the examinations for the issuance of licenses. It defines the different categories of license and the requirements for candidates applying for licenses in each category, as well as their specific duties. Other chapters cover renewal of licenses and the fees for examinations and the issuance of licenses. *A. R. B. Handbook No. 2*, 1*s.*

British Air Commission

Halifax Mark II Series H (NA). The latest version of the Halifax embodies numerous structural and aerodynamic improvements that have resulted in a great advance in its performance. An important feature is the increased rate of climb. The earlier Halifax had a power-operated gun turret in the nose. This has been replaced by a large nose. The removal of the turret has made available increased space for the navigator and bomb aimer, the latter now being able to sit when he so desires and alternatively lie in his operational position.

The new nose affords a view in all directions and permits an improved distribution of equipment. The bomb aimer is equipped with a Vickers "K" gun, firing through the nose.

The Rolls-Royce Merlin 20 has been replaced by the Merlin 22. This has added materially to the speed of the aircraft. The dorsal turret which before carried two 0.303-guns has now been replaced by the Boulton-Paul Defiant-type four-gun turret. This has added materially to its defensive power.

Additional alterations are as follows: new type of radiators with attendant changes in cowling design; abolition of the wireless mast, the aerial now being attached directly to the top of the DF loop; bottom surface tank vents; lowered astral dome; sealed engine nacelles; fuselage sealing at rear bulkhead; elevator spar gap sealing; semiretractable tailwheel; close-fitting type flame dampers replacing the old type elephant cars; abolition of fuel-jettison pipes at the trailing edge of the wing; large type bomb doors, to enclose fully the largest bombs. *B. A. C. No. 12*, June, 1943.

British Information Services

The Equations of Hydrodynamics in a Very General Form. W. F. Cope. The equations of hydrodynamics contain symbols that represent the physical properties, density, viscosity, etc., of the fluid. In the simplest applications these are regarded as constants (including as a particular case zero), and with this assumption the theory has been thoroughly investigated.

The next simplest case is when the fluid is treated as compressible, and here again considerable progress has been made. In recent years, however, it has become increasingly important to have as exact a knowledge as possible of the effect of allowing other quantities, especially viscosity, to vary. Certain particular cases in this category referring to circulation theorems have been worked out, but so far as is known no general treatment exists. This report is an attempt to fill this gap by deriving the general equations when all the physical properties of the fluid vary.

These equations are derived in a general form for a fluid, all of whose physical properties are variable. Vector analysis is used. It is shown that in some circumstances the formula derived is an integral of the energy equation.

The transformation formulas to any coordinate system are given. *Ministry of Aircraft Production, Aeronautical Research Committee, R. & M. No. 1903*, New York, $0.40.

Whichever Way the Wind Is. J. E. Hodgson. The history of the "aerial steam carriage" designed and patented by William Samuel Henson is reviewed briefly, and a biography of that British engineer is given. A brief description of the aircraft is included, as well as comments on other aeronautical investigators of the period, including Sir George Cayley, John Chapman, and John Stringfellow. *Britain*, August, 1943.

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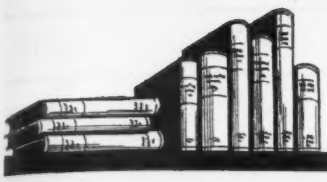

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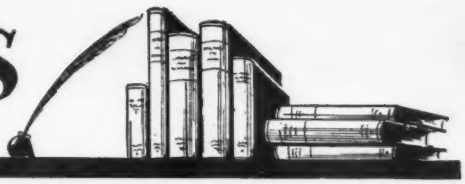

Books reviewed in this section may be borrowed without charge from The Paul Kollsman Library, Institute of the Aeronautical Sciences, 1505 RCA Building West, 30 Rockefeller Plaza, New York 20, N. Y.

Aircraft Electrical Systems

William F. Jorch

Chapters: Test Equipment and Instruments; Symbols; Generators; Generator Control Panels; Batteries; Starters; Ignition; Wiring; Questions and Answers.

The author's purpose in writing this book was to aid the mechanic or student in acquiring a thorough understanding of aircraft electrical units so that in their maintenance and servicing he will be able to recognize conditions that need attention, locate causes of trouble with quickness and certainty, and know how to put the equipment in good order. The book is designed to give in understandable, usable form the information required by a competent mechanic.

Emphasis is placed on practical objectives. While some electrical theory is included, it has been kept to a minimum. The major portion is devoted to a discussion of the most frequently encountered types of generators, batteries, ignition, and starting systems. Simple and speedy methods of testing such equipment are suggested. Explanations are nontechnical and of general application, specific types of units being referred to simply as typical of their kind and the aim being to equip the user with a knowledge of basic features common to all electrical apparatus and to enable him to make full and effective use of the manufacturer's instruction books. The Ronald Press Company, New York, 1943; 208 pages, $3.00.

Vertical Warfare

Francis Vivian Drake

Chapters: The Principles; The Tools; The Moving Targets; Stationary Land Targets; Precision Bombing; The Air Plan.

The thesis of this book is that in military operations in modern warfare out of every 1,000 men mobilized at least 500 may be killed, wounded, or never heard from again, but that in vertical warfare the loss in personnel is infinitesimal by comparison. A plan of continous bombing is outlined which the author believes would "point to a total of 4 to 6 months from the beginning of the first all-out phase to the final collapse of Germany." He attributes the program to the opinion of professional airmen and shows that it is solidly founded on experience and fact.

Heretofore, almost all books on air strategy have had to use theoretic assumptions. This book uses actual experiences to support its contentions. It demonstrates by text and by illustration the success of bombardment in the present war and shows how, by stepping up production so that 3,000 bombers would be available in the first phase of the air attack on Germany and 4,000 in the second phase, the war could be brought to a victorious conclusion in the shortest possible time and with the least possible loss of life.

The book does not minimize the great problem of production, supply, and training that would be necessary to carry forward such a continuous attack. It asks the question: "Shall we deliver the great blow by massed air power with bombs or shall we deliver it by the traditional method of land power and gunfire?" On one side might be placed the loss of upward of 5,000,000 soldiers and, on the other, principally matériel with comparatively small loss of life.

The orderly presentation of the airman's point of view on the advantage of the use of air power alone to win the war is Douhet brought up to date with actual demonstrations. Doubleday, Doran and Company, Inc. Garden City, N.Y., 1943; 142 pages, $3.00

The War Plane and How It Works

Captain Burr W. Leyson

Chapters: Machine Guns; Synchronization; From Shot Guns to Cannon; Power Turrets; Sound and Fury; War Gases; Plane Performance; How It Flies; The Engine; The Supercharger; Gyro Instruments; The Ultimate Speed of the Warplane.

With the clarity of description and presentation which is characteristic of all of Captain Leyson's books, he shows in the latest of his writings how a warplane flies, how it is powered, and explains the different kinds of armament used.

The interest in the various types of airplanes used in war has superseded interest in the "giant airliners" of a few years ago. Fire power, speed, and maneuverability have taken the place of comfort, safety, and reliability.

It has been the aim of the author to set forth in simple, nontechnical terms the manner in which the warplane operates and the working of its guns, bombs, and engines. In doing this he makes the complexities of air warfare clearer to the layman and helps to give a better understanding of the tremendous task that our Army and Navy air forces have accepted and are accomplishing with such success. E. P. Dutton & Co., Inc., New York, 1943; 224 pages, $2.50.

America's Navy in World War II

Gilbert Cant

Chapters: The Fleet and the People; Trends and Traditions; Wings Over the Water; Preludes to War; The Lightning Strikes; A Fighting Retreat; The Indonesian Barrier; Hit and Run; Bomb Tokyo!; Battle Beyond the Horizon; Crisis at Midway; Stern and Fogbound Coast; Tin Fish for Tojo; Atlantic Front; In the Middle Sea; Unlimited Liability; Which Way to Tokyo?

This correspondent gives an analysis of the engagements fought by the Navy during the present war. Having access to more complete reports than the public, he evaluates the many actions with as complete background information as it is possible to secure at this time.

The first chapter is critical of the Navy's policy of withholding information that he believes the public is entitled to have. He quotes the order prohibiting any naval officer from giving any information to anyone unless it is necessary to him in the performance of his immediate duties. He characterizes the policy as producing ludicrous results and being so restrictive as to suggest the suppression of information in a totalitarian dictatorship rather than the maintenance of security in a democracy. In the author's opinion it defeats its own purpose because it is negative and suppressive. He criticizes the Navy's role of the "silent" service as a disservice to the nation.

In the description of sea power and air power he asserts blandly that "proponents of aviation" overlook that man cannot live in the air or on the sea but requires a land economy. He refers to the Royal Air Force that won the Battle of Britain as "a dismal failure" and criticizes it for not recognizing the value of dive bombing. Of the situation of the United States he asserts that "the aviation industry and some of its least persuasive spokesman laid down such a barrage of propaganda"

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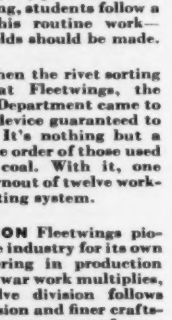
HYDRAULIC VALVE DIVISION Fleetwings pioneered in the aviation valve industry for its own ships and is still pioneering in production methods and shortcuts. As war work multiplies, Fleetwings' hydraulic valve division follows through with greater precision and finer craftsmanship. Watch for the announcement of a new group of slide selector valves.

THE ARROW, Fleetwings' monthly magazine, will help you to keep informed. In its pages are described the new production methods, shortcuts, and news of interest to men and women in the aircraft industry. If you'd like to receive a copy each month, write us on your company stationery. Send your request to "THE ARROW," Fleetwings, Inc., Bristol, Pa., Plant No. One.



FLEETWINGS

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for a separate air force that the energies of the Army and Navy aviation specialists were dissipated in fighting the lobbyists on the home front.

There is criticism of the lack of coordination between the high command in Washington, in Hawaii, in the Philippines, and on the Eastern Sea Frontier. The opinion is expressed that practically all armed forces of whatever kind situated along the coast for its defense and for the defense of nearby sea lanes should be under naval command but that some of the square pegs should be removed from round holes. The recommendation is made that the quieting of the arguments of extremists on all sides will permit hearing the approach of the enemy and devising plans for his defeat.

The description of the naval actions in the Atlantic and the Pacific emphasize the dominant role that aircraft has played and relegates the battleship to an inferior position in the future by the positive statement that the "carrier has become the Number One capital ship of World War II."

Even with the bias that is evident in the mind of the author, the book gives an excellent survey of the tactics and strategy of our Navy during the first year of the war. While depressing reading in the parts where the enemy was surprisingly successful, it is encouraging to learn that the author believes that the necessity for defense is now at an end and the historical tradition of the U.S. Navy for offensive action will soon open the way for a war of attrition which will end over Tokyo. The John Day Company, New York, 1943; 432 pages, $3.75.

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Introduction to Sea and Air Navigation

W. M. Smart

Chapters: Geometry of the Sphere; Position on the Earth's Surface; Direction on the Earth's Surface; The Mercator Chart; Dead Reckoning; Determination of Position from Observations of Terrestrial Objects; Determination of Position by Means of W/T Bearings; Effects of Tidal Streams and Winds; Rhumb-Line Formula. *Appendices:* Deviation Table; Deviation Curve; Trigonometrical Ratios; Answers to the Exercises.

A first course on the fundamental principles of navigation is offered. The course requires only a knowledge of simple trigonometric functions. A brief summary of these functions is given for information and reference. In writing this book the author's object has been to give the student an understanding of the foundations of the navigation methods used at sea and in the air because, he states, rule-of-thumb methods bring little confidence and often cause confusion. Purely technical matters, such as the use of parallel rulers and magnetic-compass correction, are not discussed in detail. Longmans, Green and Company, New York, 1943; 113 pages, $1.50.

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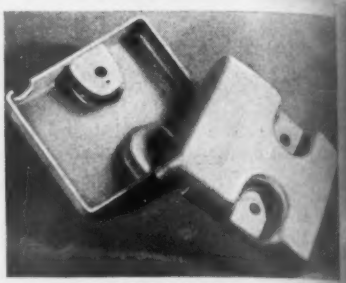

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Astronomical Navigation

W. M. Smart

Chapters: Preliminary Geometrical Principles; The Celestial Sphere; The Astronomical Triangle; Greenwich Mean Time; Observation of Altitude; The Astronomical Position Line; The Air Astronomical Navigation Tables; Miscellaneous Topics.

A detailed explanation of the principles of astronomic navigation according to present practice is presented in what the author calls as simple a way as is possible. It is assumed that the reader is familiar with the fundamental principles of sea and air navigation, but he does not require mathematical knowledge beyond the simple trigonometric functions. The book is intended to give the reader a knowledge of the astronomic foundations of navigation. Present day methods of astronomic navigation are fully discussed.

Appendix A gives a summary of the basic formulas of spherical trigonometry. Appendix I (a-d) contains extracts from the Air Almanac, and Appendix II (a-d) includes extracts from the Astronomical Navigation Tables. Answers to the examples and Star-Charts complete the book. Longmans, Green and Company, New York, 1943; 120 pages, $1.50.

Aircraft and Engine Mechanics' Manual

Charles A. Zweng

Chapters: Mechanic Certificate Amendments; Civil Air Regulations—Mechanic Rating; Procedures Governing Repair—Alteration of Aircraft and Aircraft Engines; Aircraft Mechanic Rating; General Maintenance; Ignition; Carburetion; Lubrication; Multiple-Choice Examination, Aircraft and Its Engine; The Written Examination, Airplane Mechanic, Engine Mechanic; Questions on Engines.

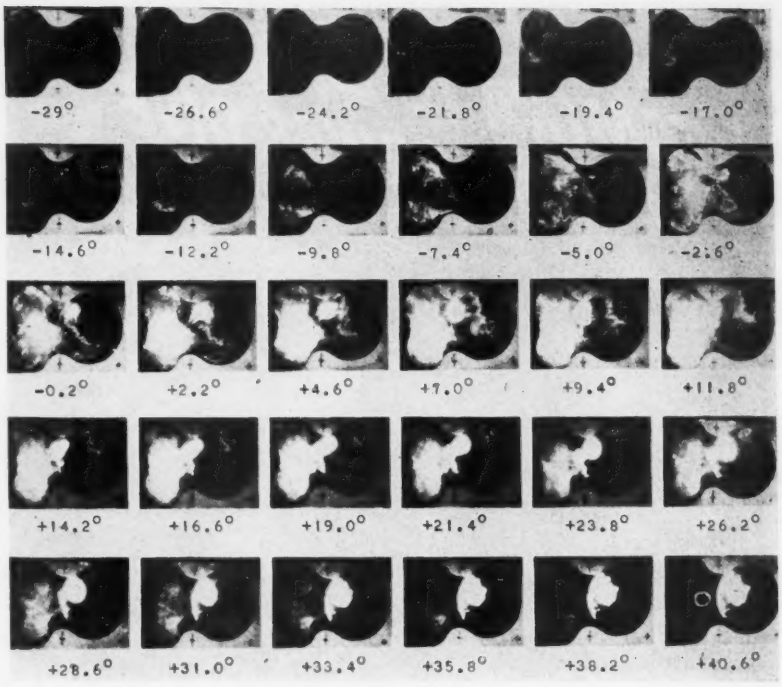
A manual written for the purpose of preparing an applicant for a rating as an airplane and engine mechanic. In the preparation of the text, the author has followed the methods of procedure and repair recommended by the Department of Commerce. The questions-and-answer method of presentation is used. Samples of the "multiple-choice" examinations now being given by the Government are included in the manual Pan American Navigation Service, North Holywood, Calif., 1943; 192 pages, $3.00.

Mathematics of Flight

James Naidich

Chapters: Mathematical Shorthand; The Equation; Ratio, Scales, and Proportion; Angles and Construction; Similar Figures and Scale Drawing; Trigonometry; Center of Gravity, Stability and Control; Basic Principles; The Lift of an Airplane; Wing Drag and Parasite Drag; Level Flight; Climbing, Gliding, and Turning; Review Test; Introduction to Aircraft Research; Aircraft Directory: Important Facts About Modern Airplanes.

The purpose of this book is to supply the essential topics in secondary-school mathematics required for aviation training. Furnished with the mathematics is a background of aviation information intended to be of value to the aviation student. The basic fundamentals of aerodynamics are treated from a carefully prepared mathematical point of view which should be within the understanding of the student. The book is offered not as a refresher but as a complete text on the subject. The author is Chairman of the Department of Mathematics of the Manhattan High School of Aviation Trades, New York City. McGraw-Hill Book Company, Inc., New York, 1943; 409 pages, $2.75.



Flame movement of single nonknocking explosion in engine running at 2,000 r.p.m. These photographs were taken at a speed of 5,000 frames per sec. (From *The Chemical Background for Engine Research.*)

The Chemical Background for Engine Research

Edited by R. E. Burk and Oliver Grummitt

Chapters: A Survey of Combustion Research, by Ernest F. Fiock; Chemical Thermodynamics of Hydrocarbons, by Frederick D. Rossini; Synthetic Methods for Hydrocarbons, by Frank C. Whitmore; Kinetics of Flame and Combustion, by Guenther von Elbe; The Experimental Side of Combustion Research in Engines, by Bernard Lewis; Some Physicochemical Aspects of Lubrication, by O. Beeck.

Volume 2 in the series on "Frontiers in Chemistry" contains six lectures that were given at Western Reserve University by a group of scientists, each in his respective field, based on recent investigations and interpretations of combustion processes and lubrication in internal-combustion engines. It is intended to be of assistance to universities having a limited staff of professors who may be specialists in certain fields but who cannot hope to master the entire related fields. It is also offered for industrial research departments and the individuals therein to give a broader coverage of scientific work related to their specialties.

One of the problems of universities is in keeping students abreast of the forward movement of science. There is also a tendency for the individual research man to work in a rather narrow field and to lose touch with the broader aspects of his field. To meet these difficulties, Western Reserve University conceived this idea of inviting distinguished scientists in the field of chemistry and closely related fields to present lectures. The lectures contained in this volume represent different, though definitely related, lines, giving a connected course and a cross section of important research work. Interscience Publishers, Inc., New York, 1943; 297 pages, $3.50.

Basic Mathematics for Aviation

Frank Ayres, Jr.

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In preparing this volume the author's object has been to provide in a single book the mathematical part of the Army

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Air Forces College Training Program. Both the arrangement of the topics and the topics themselves follow rather closely the syllabus provided by the Army Air Forces. The book is intended to enable the student to teach himself the mathematics required for pre-Army training.

The first part of the text is a rapid review of the student's earlier training in mathematics. An effort has been made to enrich this material by giving a variety of simple applications and by introducing some new material.

The theoretic aspects of the subjects have been curtailed and formal proofs have been largely eliminated in accordance with the nature of, and directives for, the course. Except in the case of certain formulas used in solving triangles, an attempt has been made, by the use of simple problems and other devices, to keep the student from feeling that much of the material consists of tricks and formulas. Houghton Mifflin Company, Boston, 1943; 225 pages, $3.25.

Manual for Aviation Cadets

Lt. John R. Hoyt

This manual is designed to supplement the training of aviation cadets in the Army, Navy, or Civilian Pilot Training courses. In writing the book the author's aim has been to teach the student right impressions, attitudes and ways of thinking. Maneuvers are described in the way a flight instructor would present them.

Emphasis is placed on the mental approach to the problem of learning to fly. The student is provided with an understanding of the mental procedure that pilots use when they take off, bank, glide, land, and maneuver. Whittlesey House, McGraw-Hill Book Company, Inc., New York, 1943; 199 pages, $2.50.

Aerology for Pilots

Chapters: Wings in the Weather; Cloud Types; Humidity and Precipitation; Atmospheric Heat; Heat Energy in Action; Pressure; Wind; More Wind; General Circulation of the Atmosphere; Air Masses; Warm Fronts and Cold Fronts; Cyclonic Depressions; Weather Maps; Sequence Reports; Icing of Aircraft; Thunderstorms; Fog; Weather over Mountains; Tropical Cyclones; Climate over the Oceans.

Written especially for aviation cadets, this book is intended as an introduction to the influence of the weather on flying. The nature and behavior of the atmosphere are discussed with reference to their many relationships to flying. Emphasis is placed upon understanding of the weather reports, favorable flying conditions, and how to avoid or conquer weather hazards.

The author has concentrated on practical applications rather than on theory in covering the subjects. The text is so planned that each chapter may be treated as a teaching unit for one 40- or 50-min. period.

The book is one of a flight-preparation training series published under the supervision of the Training Division, Bureau of Aeronautics, U.S. Navy. McGraw-Hill Book Company, Inc., New York, 1943; 107 pages, $1.25.

A Pre-Flight Aeronautics Workbook

Hubert A. Bauer

The publication of this workbook was prompted by the decision of the Civil Aeronautics Administration to grant a certificate of aeronautical knowledge to students of aeronautics in high schools who successfully pass the prescribed written private-pilot ground-school examination. The workbook is also intended to serve as a means of preparing any student of aeronautics for ground-school examination. A foreword in which the scope and emphasis of the problems are briefly discussed precedes each of the four sections. The John C. Winston Company, Philadelphia, 1943; 174 pages, $1.00.

Metals and Alloys Data Book

Samuel L. Hoyt

Chapters: Test Specimens; Hardness Tests; The Wrought Steels; The Cast Steels; Stainless Steels; The Cast Irons; Heat- and Corrosion-Resistant Casting Alloys; The Non-Ferrous Alloys; Additional Metals; General Data.

A compilation of data on the ferrous and nonferrous metals and alloys for the use of metallurgists, engineers, and students. By leaving out descriptive matter and concentrating on data, the author has succeeded in covering the large field of metals and alloys in considerable detail in a relatively small space.

The book is not intended for instruction but to give information. Reinhold Publishing Corporation, New York, 1943; 334 pages, $4.75.

1000 Pre-Flight Problems

W. H. Thompson and M. L. Aiken

A book written with the object of making clearer to preflight students the basic principles of preflight instruction by practical mathematical applications. With few exceptions, the problems can be handled by those who have had one year of high school algebra as it is now taught. In some cases, fairly complicated aerodynamic formulas have been simplified. A familiarity with the use of logarithms will facilitate the handling of the work, especially where problems involve the taking of a square root. The ability to do ordinary problems on the slide rule will reduce the amount of time required to a minimum. Answers have been purposely omitted from the book. Harper & Brothers, New York, 1943; 160 pages, $0.88 (cloth bound edition, $1.20).

Book Notes

One of Our Pilots Is Safe, by Sqd. Ldr. William Simpson; Harper and Brothers, New York, 1943; 226 pages, $2.50.

The author, a Royal Air Force pilot, was flying in France during the long *sitzkrieg* and was horribly burned on the first day of the *blitzkrieg*. The book, which he claims was "written for America," describes the harrowing details of his treatment in inadequate French hospitals and prisons.

He finally was permitted to return to England as incapable of further combat service. The agony and horror of his experiences will leave the reader with wonder that anyone could endure such torture and humiliation and yet live to write a book intended to arouse the interest of Americans in such gruesome events.

Malta Spitfire, by George F. Beurling and Leslie Roberts; Farrar & Rinehart, Inc., New York, 1943; 235 pages, $2.50.

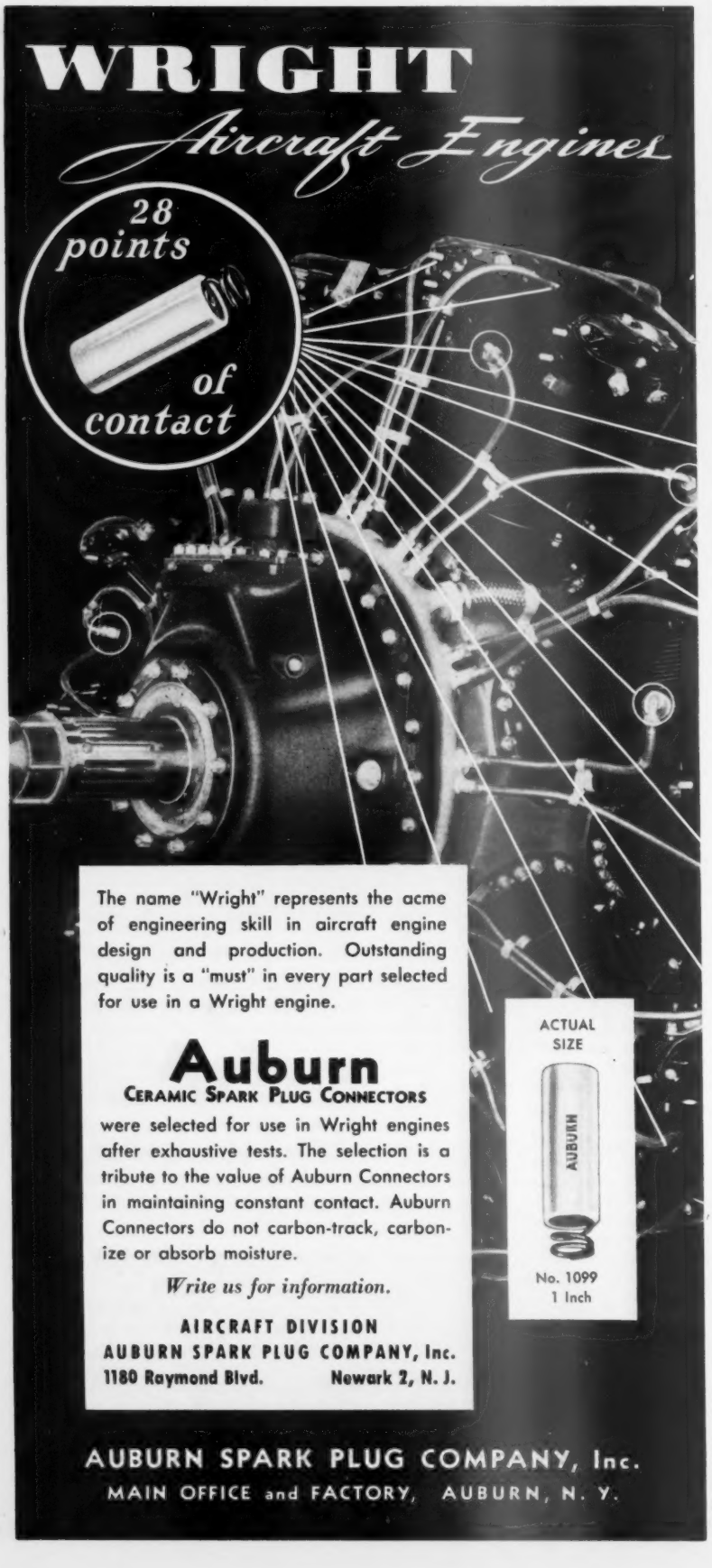
A young Canadian relates his experiences as a Spitfire pilot. The story follows him from his entrance into the R.A.F. through the active part he played in the defense of Malta. It describes his thoughts and reactions, as well as his deeds in the 14 flying days when he destroyed at least 27 enemy aircraft and damaged eight others over the heavily bombed island.

Survival; Airlines War Training Institute, Washington, D.C., 1943; 116 pages.

This manual is designed to help aircraft crews who are forced down in isolated parts of the world. It includes suggestions for obtaining food, building shelters, traveling, protection against disease, lifesaving, and first aid. The contents are divided into four sections: (1) Survival in the Arctic; (2) Out of the Jungle; (3) Survival in the Desert; and (4) Conquering the Ocean.

Rand McNally Air-Age Map of the World; Rand McNally & Company, Chicago, 1943; $0.75.

A new map by Rand McNally presents a view of world distances as they can be traversed by air. The perspective shows the North Pole and the Arctic Ocean as the hub around which the continents are clustered in virtually one land mass. The projection used is the Azimuthal Equidistant Polar Projection. On the reverse side of the map, air-line distances between 45 world cities and steamship distances between 25 world ports are listed.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Flight Food, by T. Kent Morris; Jaffe & Jaffe, Los Angeles, 1943; 32 pages.

This booklet on air dietetics takes into consideration the physiologic effects of flying on the human system and advises on the correct foods to be eaten before, during, and immediately after flight.

After explaining the effects of altitude on the human and presenting a series of dietetic definitions, it goes on to discuss the proper foods and fluids for airmen. Types of foods that should be avoided are designated. The topics of food service, supplies, and equipment for air travelers are also covered.

Airscrews for Models, by R. H. Warring; The Harborough Publishing Company Ltd., Leicester, England, 1942; 61 pages, 2*s*.

Theories of propeller design and their application to the practical design of models are given in a book for model builders. The analysis of propeller design requires the use of mathematics, but the author has endeavored to be as concise as possible in covering the basic principles. Sections cover the blade element theory, the amplified vortex theory, the slipstream, airscrew interference, airscrew design and layout, fluid free-wheeling and folding airscrews, variable pitch airscrews, and carving the airscrew.

Love at First Flight, by Charles Spalding and Otis Carney; Houghton Mifflin Company, Boston, 1943; 160 pages, $2.00.

A humorous book on the experiences of a Naval Air Cadet. In the vein of *See Here, Private Hargrove* and other amusing stories of military life, the adventures of the cadet are followed from the time he applies for naval air training until he is graduated as an Ensign.

Radio Troubleshooter's Handbook, by Alfred A. Ghirardi; Radio & Technical Publishing Company, New York, 1943; 744 pages, $5.00.

Nine sections of new material have been added to the third edition of this handbook, which is designed to supply practical factual servicing data that will help the radio serviceman in his daily work at the servicing bench. It is intended to facilitate as much as possible his task of caring for home, portable, and auto-radio receivers; automatic record changers; and instantaneous recorders of all types. Illustrations and data have been revised and brought up to date. Seventy-five essential subjects are covered in the volume.

Scale Models by Wylam, by William Wylam; Air Age, Inc., New York, 1943; 63 pages, $1.50.

Detailed layout plans and instructions are given for building scale models of operational aircraft. The book contains all of the author's drawings which have been published in *Model Airplane News*. Plans of British, American, and German airplanes are included.

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. . . *the faster, cheaper assembly of aircraft parts by stitching*

WIRE stitching to speed up the assembly of unstressed airplane and glider parts has advantages over both riveting and welding. It increases production. It lowers cost. It does not require skilled labor.

The wire stitching of metals is not new. Automobile makers have used it for several years. But, wire stitching of aircraft parts is a recent development. It calls for an unusual combination of properties, in the wire, that even the highest tensile wire used in normal metal stitching does not adequately meet.

The wire for aeronautical stitching must be hard enough to penetrate substantial thicknesses of the various materials used in aircraft construction. Yet it must be capable of being bent over sharp right angles to insure a complete contact between every portion of the formed staple and the base metal. The wire, too, must have high resistance to shear; must resist vibratory stresses; must withstand the corrosive conditions met in flying service.

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This wire is tough and ductile enough to form sharp, tight corner bends so that it clinches flat on the underside to provide full bearing on the material. Yet it is so hard that it actually punches a clean slug out of the base metal about the size of the wire itself. Thus it produces a *clean* hole—with no tearing puncture in the base metal nor burring of the hole. No cracking of the metal occurs with its attendant notch effect that might localize high stresses under vibration.

U·S·S American Aircraft Stitching Wire will penetrate gauges up to .035" for stainless steel—up to .060" for SO aluminum and up to .040" for 24ST aluminum. It is heavily coated with a tightly adhering zinc coating to withstand a minimum of 300 hours salt spray test.

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Manual for Instruction in Military Maps and Aerial Photographs, by Norman F. Maclean and Everett C. Olson; Harper & Brothers Publishers, New York, 1943; 138 pages, $1.75.

A basic course of instruction in the reading of military maps and aerial photographs is offered. It covers what the soldier should know about the subject, irrespective of the service to which he may later be attached. The manual is also suited for civilian use. No material has been introduced that does not bear directly on how to read the ground. All the units of instruction, with the exception of three chapters specifically devoted to field exercises, have been planned so that they can be taught either in the field or indoors. Each unit of instruction is intended to be 1 hour in length. The explanations are put in the outline form of lecture notes, somewhat expanded so they can be understood by everyone.

Navigation for Mariners and Aviators, by Capt. David Polowe; Cornell Maritime Press, New York, 1943; 528 pages, $5.00.

Five important problems of navigation are covered in this book: dead reckoning; latitude by meridian altitude; longitude and compass error by summer line positions; initial course and distance by great circle sailing; and identification of an unknown star. All celestial navigation is worked by the short method of H. O. No. 208 (Dreisonstok).

Special chapters are devoted to the history of navigation, piloting, fog, meteorology, practical astronomy, azimuth and amplitude determinations, right ascensions, declination, time, Greenwich Hour Angle, National Almanac, the sextant, and a day's work.

War Subject Headings for Information Files (second edition); Special Libraries Association, New York, 1943; 69 pages, $2.00.

Second and revised edition of a library guide for subject headings on current war material. Four separate lists are presented. One, prepared by the Council on Foreign Relations Library, emphasizes European war aspects. Another, compiled by Time, Inc., is a classification plan for war-clipping files.

The list contributed by Standard & Poor's Corporation Library applies specifically to economic phases in the United States only, while the one presented by the Cleveland Public Library stresses the popular point of view and civilian defense. It is this latter list that has been entirely revised and expanded.

Wanted: Women in War Industry, by Laura Nelson Baker; E. P. Dutton & Company, Inc., New York, 1943; 215 pages, $2.50.

With the aircraft industry rapidly approaching the 50 per cent mark of women employees, any book that helps to provide a better understanding of the better half of all employees is a definite aid. Executives, foremen, and lead men have been confronted with problems as uncertain of solution as the management of women both singly and in groups has ever been.

The adaptation of women to work previously done by men has been no simple undertaking. This book informs women not only how to find jobs and how to start in their new occupation but, equally important, how to reorganize their lives so that there will be as little dislocation of family routine as possible.

For the woman who wishes to enter industry a brief description of the kinds of work she may expect to be given will let her know that she will have to develop a specialized skill and fit into a huge machine of factory employment.

As an ever increasing number of women will be required to leave their homes and engage in industry, such books as this are needed to indoctrinate women with the idea that war work is just as important for them to consider as it is for men.

Wings for America, by Marshall Dunn and Lloyd N. Morrisett; World Book Company, New York, 1943; 244 pages, $1.00.

This book is one of a series of textbooks titled "America at Work." Each chapter follows the usual form of primary textbooks by emphasizing the nomenclature and trade terms and ending with questions, optional work, and a list of useful books.

Like all textbooks for beginners, the chapters are written in simple, direct style, avoiding any technical wording that could not be understood by the average boy or girl.

In addition to the review questions at the end of each chapter, the book contains an appendix, giving silhouettes of 42 types of commercial, private, and military airplanes, and a glossary. A silhouette quiz is included as an aid in the study of aircraft recognition.

The Raft Book: Lore of the Sea and Sky, by Harold Gatty; George Grady Press, New York, 1943; 140 pages, $3.25.

It is startling to read that one of the greatest experts in navigation claims that anyone without previous knowledge of the science and without instruments can find his location on the high seas and lay a course to the nearest land simply by using a small book that should be part of the equipment of any life raft. But the reader will not have thumbed many of the pages before he is amazed to find how simple it all becomes when he learns how the Polynesians sailed from island to island using birds, insects, fish, clouds, water temperature and color, wave forms and currents, and the stars to guide them.

The lore of the sea and sky, which Harold Gatty has assembled in this compact book, is the result of his having spent the greater part of his life in the South Pacific, with the opportunity for extensive research in primitive navigation. Even though one never expects to be cast on an open sea and have to use the book for its main purpose, there is no one who will not find its pages filled with information of the greatest interest to any lover of the open road. As chapter after chapter tells of indications of location through observation of things immediately in sight, admiration grows for the skill of early navigators.

Two charts come with the book. One is a Mercator projection with many tables and the other is a transparent star chart. By simplified methods any man of ordinary intelligence should be able to pilot a course with confidence. Even though he does not reach his objective he will receive a great psychologic uplift.

Spin In, Dumbwhacks, by Lt. Richard N. Ryan; J. B. Lippincott Company, Philadelphia, 1943; 153 pages, $1.75.

A human story of how a college boy joins the Army Air Forces, his welcome, hazing, and subsequent training. As Lieutenant Ryan apparently experienced all the emotions that come to a dodo, the book will let any young man who hopes to become a pilot know what to expect. The reader is conducted through the primary and basic training stages as an onlooker hearing a normal pupil receive the usual caustic comments of his instructors.

The book has merits beyond its amusing portrayal of student life in the Army Air Forces. It shows why strict discipline is required and the many difficulties that have to be overcome by the select who pass through the severe tests.

Humor is not one of the outstanding qualities in pilots. It may be hoped that Lieutenant Ryan may emulate Cy Caldwell and add to the gaiety of aviation with more stories.

Malta Story, by W. L. River; E. P. Dutton & Company, New York, 1943; 222 pages, $2.50.

If the author had not given his assurance that his story was true, the reader might have believed that it was a romance taking place in one of the most terrifying locales of the war. It relates the experiences of four American pilots who joined the Royal Air Force. Coffin was the only one of a group to return. The bombing of Malta, the agonizing experiences of the people, and the paltry air defense that could be made by the few aircraft available are described with an intimacy and directness that makes the book one of the outstanding accounts of heroism of this war.

No novel could have greater love interests than those of the English W.A.A.F. and the little Italian waitress who entwined themselves around the hearts of the American pilots. Their constancy through the incessant bombing and their final self-sacrifice is worthy of the pen of a Dumas.

No reader will lay this book down without a feeling of pride in the determination of those R.A.F. pilots who flew to their deaths against overwhelming odds to hold that essential outpost of the British Empire.

(*Continued on page 117*)

The man who jumped a thousand miles

HE HAS ONLY A FEW HUNDRED FEET TO GO NOW—but he started his jump a thousand miles away. His whole company of paratroopers and their equipment—guns, grenades, ammunition, food, wireless; even a special cannon—were sped to the fighting front by plane.

The bigger and faster our transport planes, the more paratroopers we can fly into positions where they can get the jump on the enemy.

That takes tremendous engine power—and engine power largely depends upon gasoline quality. For assurance of high octane fuel, engines can be designed to produce more power per pound of weight and per gallon of fuel.

Thanks to the pre-war efforts of the U. S. petroleum industry, war plane designers and builders today can make the most of the best. It is turning out enormous quantities of "fighting grade" gasoline—and to every gallon potent drops of Ethyl antiknock fluid are added to raise high octane ratings still higher; to pack in an extra punch.

Right now we of Ethyl are devoting our plants and people to winning the war; but, like most American business, we are making extra time to think a bit about after the war and how these new and better fuels can be put to peacetime use.

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British Air Ministry Translations in
The Paul Kollsman Library

Supplementary to the list published in the June, 1943, issue of the Aeronautical Engineering Review

Aeronautical companies and other organizations may borrow copies of these translations through the facilities of The Paul Kollsman Library upon application by the company librarian. Because of the importance of this material, the regular library loan period has been extended to two weeks, in order that these translations may be utilized to their full advantage. Requests should be made by number, author, and title on the regular Library book request cards. Because of the many requests for these translations, no more than five copies may be borrowed at one time by one organization.

The translations have been reproduced from typewritten copy and the number of pages in each is indicated at the end of each reference. Bibliographic information has been taken directly from the translations. Photostatic copies are also available at the usual library rates.

Aerodynamics

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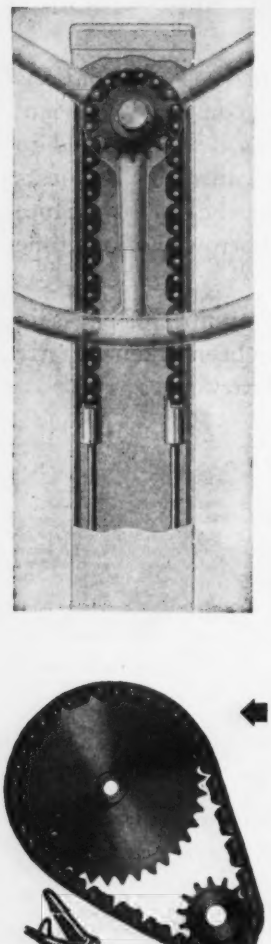

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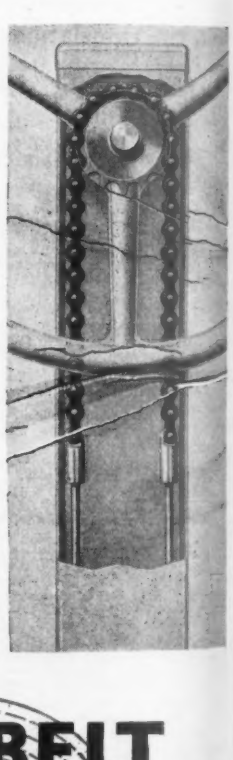

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CHAINS

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Power Plants

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Engines, Turbine

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(*Continued from page 113*)

Are We Winning the Hard Way? by Major Malcolm Wheeler-Nicholson; The Thomas Y. Crowell Company, New York, 1943; 256 pages, $3.00.

Here is a book that accepts the claims of the extremists who advocate the potentialities of air power but which adds the great possibilities of air transport to their claims. Believing, as he does, that bombing alone cannot take and hold territory over which air supremacy has been secured but that land troops must follow such attacks, the author advocates the use of paratroops and air-borne infantry to gain victory. He points out the great wastage of time and lives if old methods of warfare are followed.

The author brings historic precedents to his side in explaining the basic facts of war. Of great assistance to a better understanding of the tactic and strategic aims of the war will be his discussion of nine principles of warfare. His conclusions are that the Axis can be defeated quickly if we drop our amateur status and became professionals; if we drop all remaining concepts of 1918 tactics; if we get skilled leadership and unity of command; if we strive for real air power instead of simply air artillery; if we have air forces coequal with other services and free them from the hampering claims of subordination to land and naval dictation; and, finally, if we use sound strategy instead of the fallacies that led to the useless slaughter of 3,000,000 soldiers in the first World War.

Mercy in Hell, by Andrew Geer; Whittlesey House, McGraw-Hill Book Company, Inc., New York, 1943; 264 pages, $2.75.

A story of the gallantry and courage of a group of volunteer American ambulance drivers who were attached to the British Eighth Army in Africa. The author, a member of the first American Field Service Corps to go to Africa, gives a graphic description of the work of these unarmed volunteers in the battle of Bir Hacheim with the Fighting French and at Minqar Qa'im with the New Zealand division.

Ground Instructor, by Charles A. Zweng; Pan American Navigation Service, North Hollywood, Calif., 1943; 336 pages. $3.00.

A revised edition of the *Ground Instructor* has been issued containing the new weather code, which was not covered in the previous edition.

The material in this text covers the history of aviation, aircraft and theory of flight, aircraft power plants, instruments, aerial navigation, aeronautical meteorology, civil air regulations, and air traffic rules.

Airborne Invasion, by John Hetherington; Duell, Sloan and Pearce, New York, 1943; 178 pages, $2.50.

An account of the Battle of Crete. Together with a report of the events that took place, the author submits a study of the operations, the war losses, and the Nazi tactics that were employed.

Navigation and Nautical Astronomy by Benjamin Dutton; U.S. Naval Institute, Annapolis, Md., 1942; 516 pages $3.75.

A revised edition of this textbook on navigation is offered. In addition to general revisions, new material has been added to four of the chapters, one chapter has been rearranged, and one chapter has been rewritten. A description of the *Nautical Almanac* and *Air Almanac* has been added. Extracts from the *Air Almanac* for 1941 have been appended to the summary.

Airport Construction & Operation Reference; Reginald Burrows, Publisher, 1943–1944 Annual Edition; 96 pages, $2.00.

The 1943–1944 edition of this handbook for airport designers, managers, operators, and employees has been issued. It contains a buyers' directory of airport equipment and service, supplemented by articles on airport design factors, seaplane bases, war airfields, airport surfaces, airport buildings, airport lighting, communications and traffic control, and operations.

Armored Warfare, by Major Gen. J. F. C. Fuller; The Military Service Publishing Company, Harrisburg, Pa., 1943; 189 pages, $1.00.

It is stated that Major General Fuller's book of lectures on "FSR III" (Operations Between Mechanized Forces), first published in 1932, was a failure in England and the United States but was acclaimed in other European countries, including Germany. The present book is an annotated edition of the earlier volume, published for American distribution. It is offered as a complete manual on operations between mechanized armies.

Although the thickness of armor has increased and guns are now of larger caliber, it is held that speed and range of action are much as they were 11 years ago, and therefore no fundamental tactical change has developed that would make the 1932 ideas of the author obsolete in 1943.

Theory of Plasticity, by W. Prager; Brown University, Providence, R.I.; 158 pages.

Loose-leaf notes have been issued giving the essential content of lectures on the mathematical theory of plasticity, delivered at Brown University during the second term of the academic year 1941–1942.

The lectures are part of a course of advanced instruction and research in mechanics.

The Body Fell on Berlin, by Richard Lakin, G. P. Putnam's Sons, New York, 1943; 248 pages, $2.50.

The theme of this mystery novel centers about a Royal Air Force station and its personnel. It is purely a "who-done-it" story, but, written by a Royal Air Force officer, the background of the book adds greatly to its action.

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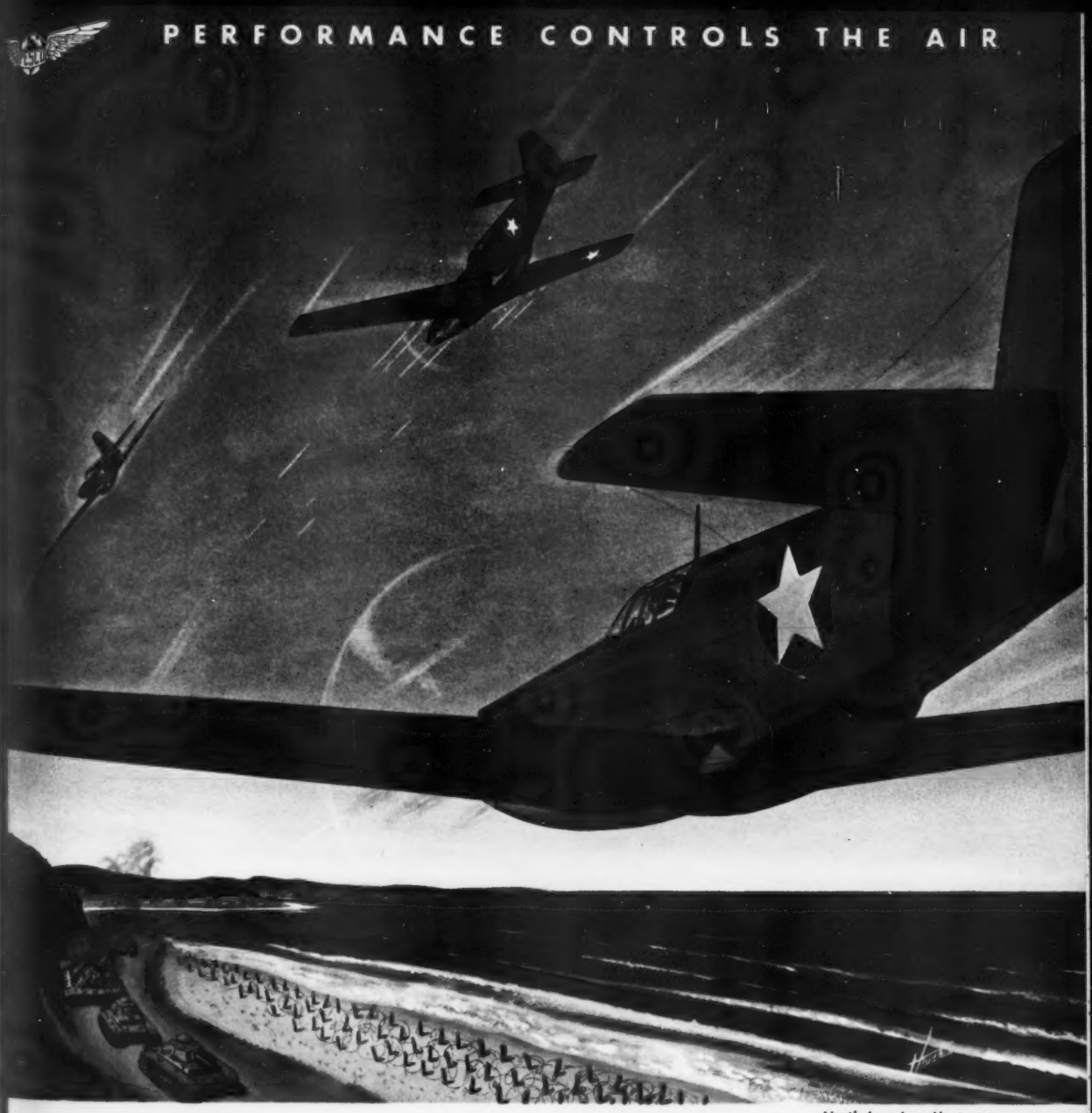

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House Organs and Catalogues

Lathe Catalogue

A 12-page file-size catalogue on South Bend 9-in. lathes, models A, B, and C, has been published by the manufacturer. It illustrates and describes both the bench and metal column base types available in the three models.

These lathes are designed for machining small accurate parts on production, toolroom, and general work. To facilitate their selection, tabulated specifications give complete information on capacities, feeds, speeds, and dimensions. *South Bend Lathe Works*, South Bend, Ind.

Aircraft Electrical Equipment

Westinghouse Equipment for the Aviation Industry is a spiral-bound industrial catalogue containing 32 pages of information, specifications, and pictures covering the manufacturer's various lines of electrical equipment designed especially for the aircraft industry. It shows the four major fields in which Westinghouse serves the aircraft industry: in the production of equipment for airplanes; equipment for aircraft manufacturing plants; equipment for ground installations such as airports and maintenance plants; and in the fields of research and development. Sections of the book give detailed specifications on a wide variety of generators, voltage regulators, dynamotors, protective and heating devices, aircraft instruments, communications equipment, lamps, and Micarta parts.

An *Instruction Hand Book* has also been recently made available, devoted particularly to 24-volt direct current systems for aircraft equipment. Its principal sections cover aircraft-engine-driven generators, silverstat generator voltage regulators, and generator current control relay switches. Each section gives detailed information on the characteristics of the apparatus covered, with instructions for assembly and disassembly, making connections, and general operation and maintenance. It is illustrated by photographs and drawings and tables contain data on names and numbers of parts. *Westinghouse Electric & Manufacturing Company.*

Specification and Data Sheets

Fairchild Aircraft Division Data is the title of the fourth in a series of color folders giving information on the organization and products of the manufacturer. It contains the latest specifications and performance figures on the different models of airplanes and assemblies in current production, as well as a list of the executive personnel of the two plants. Colored photographs are included, and provision is made for the insertion of revised sheets as they may be issued from time to time. *Fairchild Aircraft Division of Fairchild Engine and Airplane Corporation.*

Nassau at War

Illustrated by photographs of the plant interior and of some of its products, a booklet of 16 pages gives a brief history of the 33 years of growth of the Sperry Gyroscope Company, with particular reference to the new Nassau plant. The Sperry marine instruments are covered, and other pages are devoted to Sperry aeronautical products, including the gyropilot, gyro-horizon, directional gyro, automatic radio direction finder, gun turrets for aircraft, remote control for guns, antiaircraft directors, and searchlights. *Sperry Gyroscope Company, Inc.*

Design-Strengthened Sheet and Strip

A booklet of 20 pages contains principally a series of excerpts from the paper on "Design-Strengthened Materials" by Richard S. Smith and Hamilton Gray, presented at the Eleventh Annual Meeting of the Institute of the Aeronautical Sciences in January, 1943 (Journal of the Aeronautical Sciences, Vol. 10, No. 7, pp. 213–217, July, 1943). Information is given in the form of text and tables, on the tests to which the metals were submitted, and numerous photographs and drawings illustrate the methods of treating them. A list is appended of the uses to which the process can be applied, together with information on fabricating and streamlining the materials. *Rigid-Tex Corporation*, Buffalo, N.Y.

Aircraft Manufacturing Operations

Three technical manuals have been prepared to assist men and women to learn new tasks, take over new jobs, and develop new skills in the aircraft industry. They incorporate the results of experience in the operation of training programs designed to give information about the materials and processes used in the production of aircraft and to develop the necessary abilities and skills in workers from other fields. They are as follows:

Aircraft Hand Forming. A handbook of 139 pages constituting a course in this line of work contains introductory information about inspection and grading of work, safety rules, shop cleanliness, and other suggestions, having chapters covering the tools used, blueprint reading, shop mathematics, hand-forming operations, materials, and finishes. Detailed instructions are given for the performance of 24 job projects. The booklet is illustrated by numerous drawings.

Aircraft Sheetmetal Assembly. Following the introductory remarks common to all three manuals in this series, this booklet of 138 pages is divided into chapters on the tools used for measuring, layout, cutting and drilling, shop mathematics, riveting tools, metal fasteners, countersinking and dimpling, and aluminum alloys and their finishes. Instruction is given for 24 specific job assignments.

Aircraft Spot Welding. This 102-page manual was developed to serve as an elementary text in the training of spot-welding machine operators. The writers have endeavored to set forth the principles of spot welding which are accepted as the most satisfactory at present, although it is noted that the techniques are constantly being improved and some changes are to be expected. In some cases, it has been necessary to sacrifice extreme technical accuracy for the sake of clarity. Chapters cover: aluminum alloys and their finishes; weld theory and standards; material preparation; machine adjustment and operation; and welding electrodes. Test projects for shear and penetration tests are given, as well as instructions for ten job projects. *Goodyear Aircraft Corporation*, Akron, O.

Postwar Air-Line Plans

Present into Future. Outlining the function and composition of American Airlines' Planning Board and its subsidiary groups, this article tells of the program that has been inaugurated by this air line for the planning of postwar transportation. Five basic questions have been established as a guide to the plans: (1) What will be the future world economic structure? (2) What markets will exist for our service, air transportation? (3) To tap these markets, what new routes or route extensions are necessary? What new cities should be served? (4) How are we going to get our share of the business? (5) What do we need in flying equipment, ground equipment, and personnel for the future?

The development of Idlewild Airport—a new airport for New York City, located on Jamaica Bay—is cited

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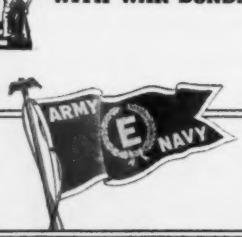

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as an example of a postwar project necessitating immediate planning. *Flagship News*, July, 1943.

Volcanic Influence on Avigation

Nace un Volcan (*The Birth of a Volcano*). The question is discussed whether the volcano Paricutin, in the State of Michoacan, Mexico, which has recently broken into eruption, has created phenomena that seriously affect air navigation. Mexican and United States scientists have taken advantage of this rare opportunity to make intensive studies of the effects of the eruption. Prof. Jose Chavez Almanza, chief meteorologist of the Compañía Mexicana de Aviación, is quoted as stating that, in reference to the phenomena created by the eruption of the new volcano, it must be admitted that they interfere seriously with air transportation in Mexico. Two regions are affected: the eastern and southeastern part toward Guatamala and the northeastern States of Hermosillo and Sonora, in which regions horizontal and vertical visibility is greatly decreased. Furthermore, the erupted ashes carry hydroscopic particles that cause an increase of precipitation in the southern part of Mexico, while violent storms are reported from zones near the volcano. *Caminos Del Aire*, May, 1943.

Commonwealth Aircraft of Australia

The Gadgeter. The history of Commonwealth Aircraft Corporation of Australia and the aeronautical career of its general manager, Wing Comdr. L. J. Wackett are briefly reviewed. Founded as a defense measure, Commonwealth Aircraft is an industrial corporation that does not operate for profit. It was established in 1935 with two broad objectives in mind: (1) In its manufacture of airplanes and airplane engines it would utilize materials indigenous to Australia; (2) the effort should be planned so that first-line defense aircraft could be produced in Australia within 5 years. The industrial organizations from which Commonwealth Aircraft was formed, the planes that have been developed by this corporation, its additional activities in building parts for and assembling planes of American design, and some of Commander Wackett's inventions are noted. *The Pegasus*, August, 1943.

Cargo Airplane Design

Looking to the Future. This article contains some data on a design for a cargo airplane, patented and assigned to The Glenn L. Martin Company by a member of its Engineering Department. The design calls for a two- or four-engined, low-wing monoplane with tricycle landing gear. Tail surfaces or empennage are not attached to the fuselage but are supported by twin-booms running out from the wings. Since the aft end of the fuselage, in which the cargo compartment is located, is thus left clear, it can be opened like a door by means of hydraulic arms for the easy loading of freight. The

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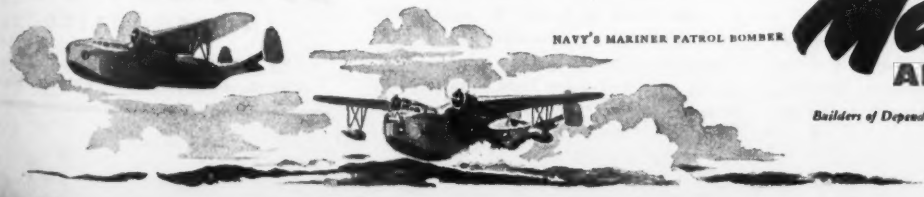

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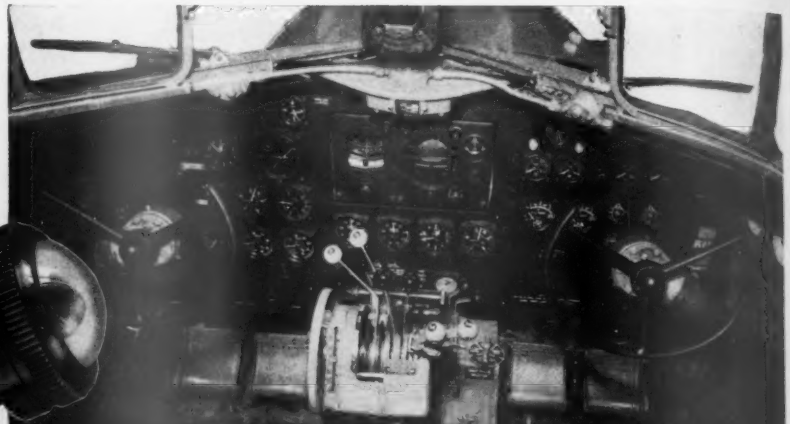

Photo illustrating typical aircraft instrument panel by courtesy of Army Air Forces Materiel Command, Wright Field.

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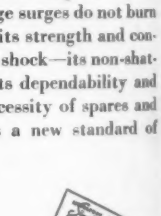

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same hydraulic mechanism used to raise the cargo door also extends a collapsible loading ramp that can be adjusted either to the ground or to the back of a truck. *The Martin Star*, August, 1943.

German Airplanes

The Competition is Good. Ralph Lyman. A brief survey of some German aircraft in which the features of each plane are noted and comparisons are made with similar American aircraft types. The planes discussed are the Messerschmitt Me 210 and 323, Henschel He 129, Focke-Wulf FW 190A-3, and the Junkers Ju 90. In evaluating the materials, workmanship, engineering, and production of the Germans, the writer cautions that they should not be underestimated. He claims that they are continuing to devise new production-line methods to keep pace with American developments. *Douglas Airview*, June-July, 1943.

Advice on Cutting Fluids

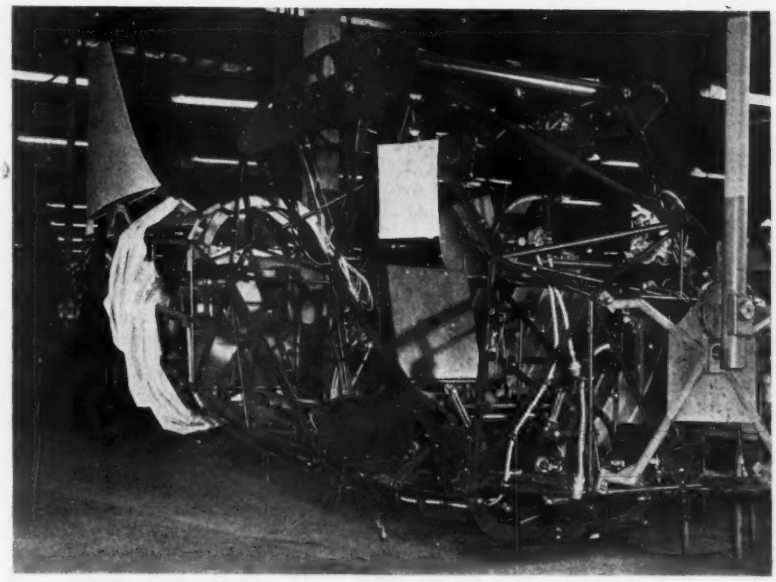
Cutting Fluids for Magnesium Alloys. A. M. Lennie. A metallurgist connected with The Dow Chemical Company gives advice on the use of cutting fluids in working magnesium alloys. The properties and machining characteristics of metal are outlined, comparing the procedures for machining it with those for other metals. The primary functions of cutting fluids are stated to be in cooling the work and reducing the fire hazard, and other results of the use of cutting fluids are mentioned. Specifications are given for proper cutting fluids. It is shown that under certain conditions dry machining may be the correct procedure. Comparisons between American practice and British practice are made, and it is indicated that American methods favor the use of cutting fluids. *The Houghton Line*, July, 1943.

Facts About Mexico

Make Friends with Mexico is the title of an illustrated booklet of 24 pages containing a variety of information about the history, customs, climate, and other features of the Republic of Mexico. Sections cover its agriculture, mineral resources, manufacturing industries, ancient cultures, and handicrafts. It gives figures and data about the different territories, tips for travelers and facts regarding the country's air commerce. *American Airlines, Inc.*

Aircraft Accessory Catalogue

Under the title *Mead Industrial Air Power* an illustrated catalogue of 24 pages covers the manufacturer's lines of air cylinders and air-operated devices or industrial applications. The new, patented air clamp is described and its uses are explained. Other types include a midget model, horizontal thrust models, work feeders, vertical thrust models, air vises, and accessories. *Mead Specialties Company*, Chicago, Ill.



This completed fuselage of a Stinson "Flying Jeep" is ready to receive its fabric covering.

Tubing in Light Airplane Construction

The "Eyes Upstairs." How steel tubing is employed in the construction of light airplanes, such as the Stinson Sentinel, built by the Stinson Division of the Consolidated Vultee Aircraft Corporation and also known as the "Flying Jeep," is related in a brief article. The services of this type of aircraft in Army cooperation are related, particularly in observation work for the artillery, tank units, the cavalry, and the infantry. Comments are made on the performance characteristics of the plane. *War Production Drive by Summerhill*, July 31, 1943.

Marauder Service School

Post Graduate Course. The Glenn L. Martin branch of the Army Air Forces Training Command, Training Detachment, is described. The purpose, activities, curriculum, and equipment of the school are given. Similar to schools set up in other aircraft plants, this one has been established to train selected Army Air Forces mechanics for the specialized servicing of Martin Marauders. The article includes notes on the foreign-duty mobile service units for which some of the students are prepared. *The Martin Star*, August, 1943.

Plant Maintenance

Maintenance Miracles. An article on the plant maintenance departments of Bell Aircraft. Indicating the varied work of these departments, three general classifications are applied to the nature of their activities: routine maintenance, preventive maintenance, and emergency maintenance. Successive steps in the factory procedure of repairing a machine are described. *The Bellringer*, August, 1943

Management Problems

Practical Aspects of Supervisory Training. C. A. Posson. A booklet of four pages contains an article on the problems involved in supervisory training and on available methods for increasing the efficiency of foremen and other supervisory shop executives. The important phases of job evaluation and personnel analysis are summarized. Report No. 143, *George S. May Business Foundation*, Chicago, Ill.

Ideas from Employees

Ten Thousand Ideas. F. L. Taylor. The Employee Proposal for Improvement Plan, inaugurated by the Lockheed and Vega Aircraft Corporations, is outlined. Representing a phase of their work simplification program, this plan invites suggestions from employees for improved production methods and pays awards for accepted ideas. In addition to giving advice on how to submit ideas, provisions of the Proposal Plan and the basis of awards are listed. A feature of the program is the course in Work Simplification given to all supervisory personnel to aid them in improving their work and to show them how to assist those employed under them to present ideas properly. *Lockheed Vega Aircraftsman*, August, 1943.

Catalogue on Plastics

Injection Molded and Extruded Plastics, Catalogue III, is a 40-page booklet, constituting a revision of former catalogues issued by the manufacturer. Sixteen pages are devoted to colored illustrations of the numerous products of the manufacturer in this class of goods, while other pages contain information on the plant equipment and facilities of the manufacturer and on the methods of producing and fabricating

the materials. The molding processes for thermoplastics, the injection and the extrusion methods, and the molds used are described. Thermoplastic materials molded by the injection process include cellulose acetate, cellulose acetate butyrate, acrylic, vinyl, polystyrene, ethyl cellulose, and vinylidene chloride. Another section of the book is devoted to technical data and physical properties. *Elmer E. Mills Corporation*, Chicago, Ill.

Prevent World War III

Stukas Weren't Enough. Stating that the United States' military record has been one of unpreparedness throughout its history, the writer urges that America no longer depend on fortuitous circumstances but be prepared for any emergency in the future. He claims that proper preparation means the development and superiority of all classes of weapons and analyzes some of the mistakes made by Germany. These include: concentration on producing offensive bombers, such as the Stuka, which was small, badly armed, short-ranged, and weak defensively; the establishment of airplane production upon the theory of quantity and static designs, without taking into consideration the necessity for constant design modifications; underestimating their enemies; and preparing for war only under certain conditions and in certain territories. The writer goes on to show how the cooperation of Britain and America in developing airplanes for specific, but unlike, purposes and in steadily striving for improved quality has helped to put the Allies on the road to victory. He mentions fields of aircraft development in which the United States has been particularly active and those that have been specially sponsored by Britain. *The Pegasus*, August, 1943.

School for Army Air Force Mechanics

Training the Army to Keep 'Em Flying. An account of how American Airlines trains Army Air Forces personnel to become airplane mechanics. With practical application forming the basis of instruction at the American Airlines' school, the students assigned there have had previous mechanical training either in civilian life or at other Army schools.

Three general courses are given: one covers engine testing, maintenance, and overhaul; another, major aircraft overhaul and maintenance; and the third, radio overhaul, maintenance, and trouble shooting. *Flagship News*, July, 1943.

The Completed Plane

A Bomber Is Born. Concluding article of a series on the design and construction of Martin bombers. This installment presents a brief overall review of the entire production process. It also describes the work of the Service Department personnel. *The Martin Star*, August, 1943.

Zinc Chromate Saving

Our First Victory. Roy Bell. Employed by the Vega Aircraft Corporation, a system for recovering zinc chromate from the residue of preservative primer is described. A large dough mixer is utilized for cleansing the paint spray sludge and removing the water from it so that quantities of the critical component may be salvaged and used again. *Lockheed Vega Aircraftsman*, August, 1943.

Trim-Tab Actuator Streamlined

Idea Shapers. A brief account of the making of a new trim-tab actuator. Developed by two Bell employees, the new device has half as many parts as the old-style trim-tab actuators and requires only 5 min. to assemble. This is a saving of 1 hour and 25 min. in the assembly of each actuator. *The Bellringer*, August, 1943.

Piping Catalogue

If It's Piping Contact Flori is a new 64-page catalogue containing illustrations and descriptions of the varied line of piping and pipe services made available to industry by the manufacturer. Standard and special piping for structural and architectural purposes, pipe bending, coils, and fittings comprise the line marketed. In addition to a review of the company's facilities, the booklet also contains tabulated specifications

EMERGENCY CALL

THIS MAN'S NOT A DOCTOR—at least not an M.D. But he's called in on a vitally important case, trouble in the glue room of a wood-working plant with war contracts. In his hand is a viscometer, one of many instruments with which he diagnoses trouble.

Chances are this man's "know how," backed by 20 years' experience of his company and his own technical training, will straighten things out in a few minutes. Maybe, if it's more serious, the cure will have to come from Laucks laboratories. But—he'll get results.

This is just another service by Laucks staff of glue men, chemists and engineers, who know glue from inside out, who see that *Laucks glues do more than merely meet the specifications.*

Take advantage of this "bonus" . . . Laucks glue service . . . get your supplies and counsel from the world's largest makers of water-resistant and waterproof glues.

I. F. LAUCKS, INC.

CHICAGO, 2—6 N. Michigan Avenue
SEATTLE, 4—911 Western Avenue
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Seattle, Los Angeles, Portsmouth, Va., Lockport, N.Y.
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Consult LAUCKS—America's Glue Headquarters

LAUCKS SYNTHETIC RESIN AIRCRAFT GLUES
MEET GOVERNMENT SPECIFICATIONS IN THE AIRCRAFT INDUSTRY

TRUE STORIES ABOUT *Vega*

HOLLAND EARTH FOR A HOMESICK DUTCHMAN

How a Vega Ventura Bomber Brought Home Dirt from the Land it Raided!

A handful of Holland earth, scraped from the bomb-bay doors of a returned Ventura medium bomber—back victorious from a smashing raid on Axis-held Europe—tells an exciting, true story of the dependability of one fighting American warplane.

1. VEGA VENTURA medium bombers were chosen for a smashing role in the big daylight raid on the Philips Wireless Works in Eindhoven, Holland. Last to go over the target, their job was to drop incendiaries from roof-top heights on factory buildings already damaged by high-explosive bombs dropped by other aircraft earlier in the raid.

2. AT TREE TOP LEVEL they swept in—lower even than the "flak towers" built to protect this vital Nazi supply center. The defensive gunfire was heavy, and many a crewman saw the interior of his Ventura clearly lighted by licking tongues of flame from burning buildings or by exploding shells.

3. LEAPING LIKE A PORPOISE, one stout-hearted Ventura was caught in almost point-blank cross-fire—but made its run and effectively dropped its bombs. Then with a staggering crash the open bomb-bay doors scraped the ground!

4. A BREATHTAKING MOMENT—Then with a surge of its two powerful engines, the Ventura fought its way up into the air again, away from danger, and across the channel to its home base in England.

5. CAKED IN THE CHINKS of its battered bomb-bay doors was a present for a homesick Hollander. It was Dutch soil—scooped from the Netherlands and brought back by the Vega Ventura—an American bomber tough enough to take a direct hit, bounce off the ground, and still fly its crew home safely.

This is another in a series of stories about Lockheed and Vega and their accomplishments. Watch the pages of this magazine for another true aviation adventure.

Vega

AIRCRAFT CORPORATION

A Subsidiary of Lockheed Aircraft Corp.
Burbank, California

Bullet wounds that **heal themselves**

EVEN before that fatal day of December 7, 1941, Shell's great research laboratories were supplying manufacturers with *butadiene*—the key to a synthetic rubber that will do things natural rubber *can't do!*

Today this synthetic rubber made with butadiene is performing one of the miracles of modern warfare! It is used to line airplane gasoline tanks . . . make "bullet-riddled" tanks self-healing. When enemy bullets pierce the tanks, the spongy rubber fills the holes, keeps the plane flying.

It is research such as this that first produced 100-octane fuel in commercial quantities . . . one of the reasons the majority of the country's leading plane and engine manufacturers prefer Shell Aviation Fuels. Shell Aviation Products are also preferred by many airlines, aviation training schools, and airports.

Farsighted airport operators will find Shell's wartime popularity a profitable peacetime asset.

SHELL

AVIATION FUELS AEROSHELL OILS

and price lists for the materials and services offered. *The Flori Pipe Company*, St. Louis, Mo.

Navigational Computers

Many aircraft navigational computers are currently made from vinylite rigid sheet—a plastic material that is recommended for the purpose by the manufacturer because it is tough, has low moisture-absorption qualities, and does not shrink or warp under the varying conditions encountered in aeronautical use. Computing instruments of this type are produced from opaque black or white rigid vinyl sheets, while protractors and other navigational plotting instruments are made of transparent sheets. The sheets are printed in one or more colors and then overlaminated with a thin transparent sheet of plastic to protect the inks. For applications where a drawing surface is required, a dull matte finish is obtained by means of a specially engraved planishing plate during the laminating process. *Bakelite Review*, July, 1943.

Radio Direction Finder

In a booklet of 22 pages, descriptions and illustrations are given of the new Sperry automatic radio direction finder. In addition to a general description, detailed descriptions cover the control unit and indicator, the use of the scale to read magnetic bearings and true bearings, the receiver, and the loop and drive mechanism. The advantages of the instrument are outlined, together with information on true electrical performance and on the Sperry dual automatic finder. *Sperry Gyroscope Company, Inc.*

Welding of Low-Carbon Steel

A four-page leaflet covers recommended practices for the spot welding of low-carbon steel. This constitutes an emergency standard prepared on the basis of information obtained from a number of fabricators of mild steel structures and resistance-welding equipment manufacturers. It is intended to meet the needs of the U.S. Navy and the War Department as well as those in industry engaged in the production of war materials.

The bulletin is composed essentially of two charts—one each for spot and seam welding, together with an explanation for their use. For example, after the metal gauge is determined, the welding electrode or roll is selected, the pressure is adjusted, and the weld time is set and a pull test made. This is the order in which the data appear from left to right on the charts. The work was initiated by the Resistance Welding Research Committee of the Welding Research Council and has been approved by the Resistance Welding Standards Committee of the American Welding Society.

Copies may be obtained from the Society at $0.10 each. *American Welding Society*, New York.

This new compact plastic blower has been designed for air circulation problems where equipment space is restricted. It is claimed to deliver 15 cu.ft. per min. at 3,000 r.p.m. The weight of the turbo-type wheel and housing is only 2 oz. The back plate facilitates mounting on any type motor.

Book on Foremanship

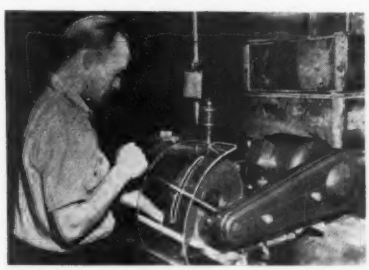
Foremanship and Accident Prevention in Industry. A book has been issued which is designed to teach foremen the principles of accident prevention. It is also suitable for use in a foremen's overall training course. Chapters cover the Foreman in Industry; Causes of Accidents; Accident Control in Manufacturing Methods; Maintenance; Housekeeping; Personnel Control in Accident Prevention; Aids to Foremen. *American Mutual Liability Insurance Company*, Boston, Mass.

Work Simplification

What's the Big Idea? Al. A. Adams., Twenty-six ideas for improving production are outlined. Suggested by Douglas Aircraft Company employees, these innovations are illustrated by a series of photographs. *Douglas Airview*, June-July, 1943.

Catalogue on Plastics

A catalogue has been issued on Monsanto plastics. Monsanto plastics are made both from synthetic resins and cellulose derivatives. The six basic types of plastics described in this catalogue are Nitron, Fibestos, Lustron, Resinox, Saflex, and Monsanto's new melamine resins. Information is given on the comparative properties of plastics, molding compounds, plastic sheets rods and tubes, rubber-like compounds and specialty resins. *Monsanto Chemical Company*, St. Louis, Mo.



Plexiglas saw-shields designed by Republic Aviation's Methods Engineering Department help prevent eye and head injuries.

Manual on Piston Rings

An aircraft-engine piston ring manual has been published by the manufacturer of Muskegon piston rings. The manual contains 48 pages with illustrations and is divided into three parts. Part I deals with servicing and inspection. Included in this section are notes and precautions for aircraft-engine overhaul and information on the inspection, cleaning, and reconditioning of the piston and cylinder barrel. Lapping operations are described, as well as the installation of piston rings.

Part II contains basic dimensions and tension specifications of various sizes and types of aircraft-engine piston rings, a description of the various types of compression and oil rings, a table of piston clearances for different makes and types of aircraft engines, a table of recommended practices for the cylinder reconditioning of different engines, piston ring setups, and clearances for different engines. A table of American aircraft-engine specifications is also furnished.

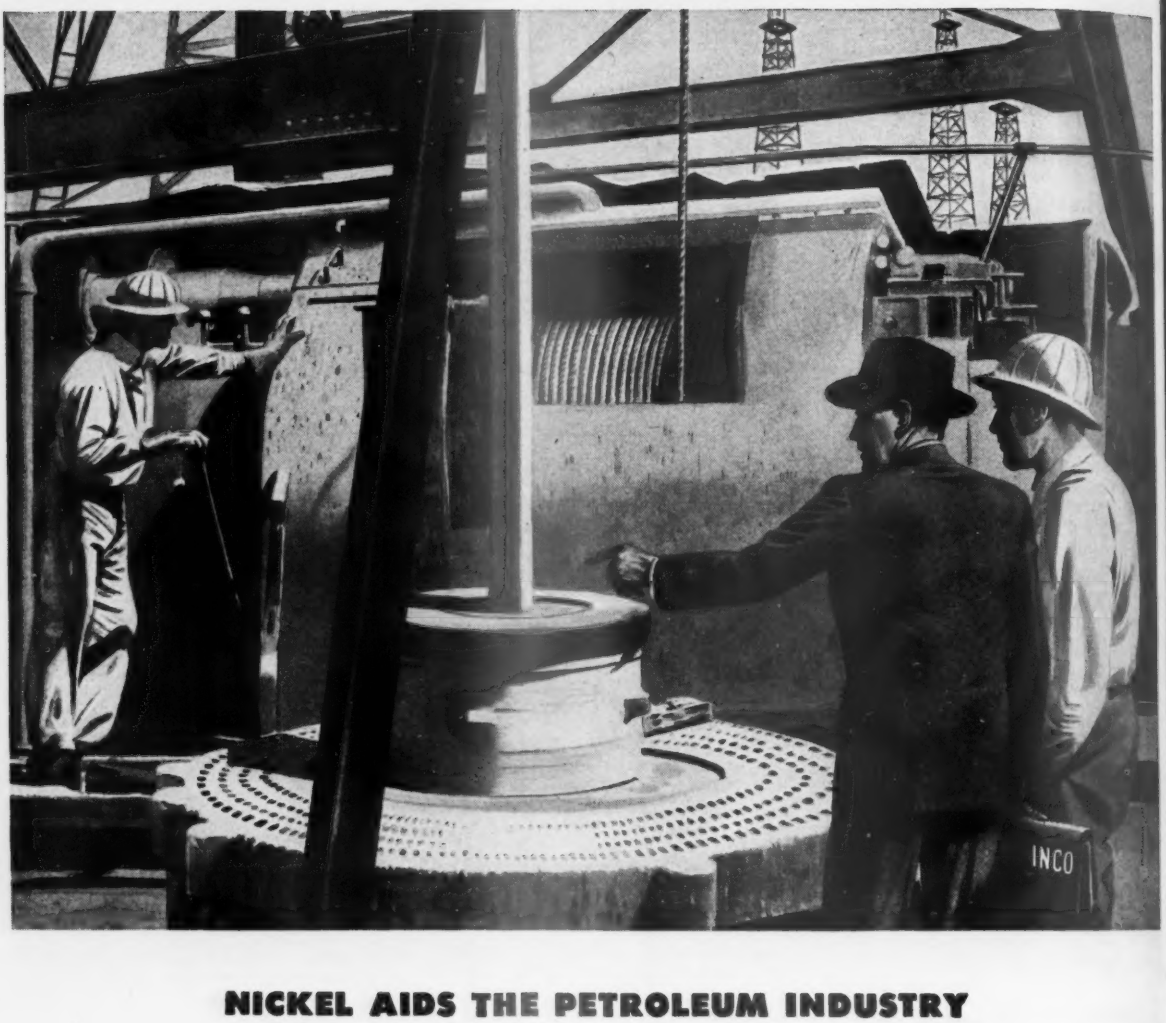
Part III discusses piston-ring and cylinder wear, factors that influence oil consumption, chromium plated rings and the manufacture of aircraft-engine piston rings. In the back of the catalogue is a millimeter-to-inch chart and a Rockwell conversion chart. *Muskegon Piston Ring Company*, Muskegon, Mich.

Teaching Teachers

What Is "J.I.T."? The principles and purpose of the Job Instruction Program are explained. Initially sponsored by the Office of Production Management, this program provides participating companies with specialists to instruct their supervisory personnel in scientific methods of teaching jobs to inexperienced workers. *Ryan Flying Reporter*, July, 1943.

Service Organization

"... *The Sun Never Sets.*" An article on the organization and operations of Lockheed-Vega's field service units. Operations are divided into four major groups: reassembly of aircraft shipped overseas by boat; modification of planes for specific combat theaters, including installation of the latest equipment; maintenance, overhaul, and repair to keep battle planes in fighting trim; and the repair of battle and operational damage. The organizational setup is outlined as follows: (1) four bases in the United Kingdom—one in northern Ireland, two in Scotland, and one in western England; (2) six mobile repair units that shuttle between remote flying fields in England; (3) two large service bases in Southern California and Texas; (4) more than 150 highly trained technical service representatives who work with Army or Navy units in the field; and (5) training school in Tennessee. *Lockheed Vega Aircraftsman*, August, 1943.



NICKEL AIDS THE PETROLEUM INDUSTRY

to KEEP 'EM PRODUCING!

Oil is ammunition. On every battle front, oil is war material number one.

Besides power for ships and subs, planes and tanks, trucks and jeeps, it also provides the basic ingredients for synthetic rubber, toluene for TNT, chemicals, and many other essential war materials.

To meet increased wartime demands for oil, field and pipeline equipment carries heavier loads. Refineries make longer runs at high heats and pressures. Engineers add sub-zero cycles and new catalysts. Equipment is taxed up to and sometimes beyond rated capacity . . . precision equipment that cannot be readily replaced.

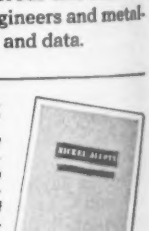
Despite emergency schedules, however, that equipment rarely fails. For, since the days when shallow wells were drilled with wooden rigs and kerosene was shipped in oak barrels, oil men have relied largely on stressed parts strengthened and toughened by additions of Nickel.

The oil industry knows many uses for Nickel alloyed materials, from crown blocks to drill bits, from sucker rods to pressure stills. Alone, or in combination with other alloying elements, Nickel helps metals resist corrosion, retard wear and absorb shock overloads. Properly used, a little Nickel goes a long way to insure dependable, uninterrupted operation of production and refining units.

For years the technical staff of International Nickel has been privileged to cooperate with petroleum engineers whose pooled information and "know-how" are now so vital to Victory. To men in all industries who desire assistance in the selection, fabrication and heat treatment of ferrous and non-ferrous metals, INCO engineers and metallurgists offer counsel and data.

New Catalog Index

New Catalog C makes it easy for you to get Nickel literature. It gives you capsule synopses of booklets and bulletins on a wide variety of subjects — from industrial applications to metallurgical data and working instructions. Why not send for your copy of Catalog C today?



* *Nickel* *

THE INTERNATIONAL NICKEL COMPANY, INC., *67 Wall St., New York 5, N. Y.*

From the Industry

Micrometer Stop Countersink Improvement

Based on the principle used in engine valve-spring design, a split keeper which gives positive set to the retainer collar on bearings is now incorporated in micrometer stop countersinks. With this positive locking feature, the makers state that no amount of vibration will loosen the bearing retainer and cause damage to the tool or material.

The keeper inserts work on the slotted, taper shaft principle. All force is directed toward the shaft center under constant, even pressure. The unit may be immediately disassembled by hand. On-the-job oiling and other required servicing can be readily accomplished.

It is claimed that the use of this locking method adds to the working life of Aero Tool stop countersinks and complements other important features incorporated in these tools. Aero Tool Company, Burbank, Calif.

Automatic Lubricator for Air Tools

An automatic lubricator for feeding a regulated oil mist into air tools is designed to eliminate the need for frequent daily oiling and prevent "freezing" of such equipment. The lubricator is recommended by the makers for use in the air hose from 1 to 6 ft. from the tool, or it may be used in air pipes for larger air-driven stationary or semiportable tools. It is also adaptable for air passages in a machine.

A positive feeding action provides a regulated amount of oil, but feeds oil only when the tool is operating. The oil reservoir holds enough oil for more than a week under normal usage. A clear Lucite window shows when it needs refilling.

Positive regulated wicking action with an automatic shut-off prevents any flooding of air tools with oil. Unless otherwise specified two standard settings are provided from the factory. Operators thus cannot tamper with oil feed settings. Air-Lube Filters, Inc., Glendale, Calif.

Portable Spark-Plug Tester

The Amsco portable spark-plug tester, Model P80, is a self-contained testing unit. It consists of a hand- and motor-driven magneto, hand-operated pressure-test bomb, and a gap-setting tool, designed to service BG spark plugs and Aero, Bendix, Champion, and AC plugs of the aircraft type. The 110-volt, 1/4-hp. motor, used for driving the magneto when alternating current is available, also has an arbor and collets for cleaning spark plugs.

Supplementing the unit's hand-pump pressure-test bomb, a small detachable bottle of carbon dioxide makes possible the testing of more than 1,000 plugs without refilling. The testing equipment mounted in a small, portable metal box weighing approximately 80 lbs., is suitable for mobile field repair units and can be easily transported in trucks, planes, boats, and tanks.

A wide variety of gauges, adapters, and wrenches and an electrode forming and adjusting tool complete the set. Airplane Manufacturing and Supply Corporation, North Hollywood, Calif.

Roll-Film Dryer

A new roll-film dryer for aerial photographic work has been developed by the Lau Blower Company in cooperation with technicians from the Army Air Corps at Wright Field. It is reported to be capable of drying film in little more than 30 min. It uses Armco Zincgrip-Paintgrip, a special zinc-coated metal that can be formed or drawn without flaking or peeling of the protective zinc coating.

The dryer is equipped with an electrical heating unit and variable-speed motor. Filters keep out dust, while the blower spreads 2,000 ft. of conditioned air per minute over the traveling film. The new dryer takes film up to 9 1/2 in. wide and 210 ft. long. The American Rolling Mill Company, Middletown, O.

Forging Ampco Metal

All grades of Ampco Metal are forgeable, although Grades 16 and 18 show the most favorable response. Forging does not improve the harder grades—having Brinells above 200—as much as it does those with lower Brinell numbers. Grades 16 and 18 are best suited for shock-resistant service and the process of forging increases that shock resistance.

The metal flow induced by the impact refines the grain and knits or keys the crystals. The metal changes from short, bulky grain to long, finger-like crystals.

Physical properties are improved and often the product lends itself more easily to machining and fabrication. Forging, of course, does not in any way affect the wear-resistant properties of the alloy which are inherent in the metal itself.

The forging of Ampco Metal should be done by those who are experienced with the metal. The hot-working temperature ranges in Ampco are critical, and such work should not be undertaken by anyone not familiar with the metallurgic practices involved. Ampco Metal, Inc., Milwaukee, Wis.

Hy-Lift Truck

Announcement has been made of a new 4,000-lb. capacity Hy-Lift truck known as the Type H-2, which combines the "self-loading" feature with tiering and is useful for both transporting and tiering skidded material.

The truck is built on a 66-in. wheelbase; the overall length, including the operator's guard, is 123 3/4 in., and the truck is designed for operation in intersecting aisles 67 in. wide. Its overall height of 83 in. permits ready entrance into box cars for loading and provides a maximum lift of 67 in. The platform is 26 1/2 in. wide, 54 in. long, 11 in. high in the low position.

The battery box has been increased in size and provides space for enough additional battery capacity so that the truck may be operated continuously on the longer shifts now in effect. Under most conditions, there is no need to stop during a working shift to change batteries.

An improved hydraulic lift system provides control of hoisting and lowering. The control lever, convenient to the operator's right hand, starts the pump motor and closes the valve, forcing oil into the jack cylinder. Lowering is by gravity controlled by the same lever. A limit switch shuts off the pump motor at the upper limit of platform travel, with auxiliary safety through a relief valve. The platform travels vertically on ball-bearing rollers running in upright channel guides. The power is supplied by a single hydraulic jack, and travel is compounded by sprockets and roller chains.

Included on the truck are such standard Baker features as the Travel Motor, designed specifically for industrial truck service; the Duplex Compensating Suspension, which eliminates all sliding contacts between the power axle and frame; and the No-Plug Controller, which provides three speeds in each direction, controlled by a single handle. Baker Industrial Truck Division of The Baker-Raulang Company, Cleveland, O.

Wood-Toughness Tester

A machine for testing the toughness of wood, recently developed by the U.S. Forest Products Laboratory, is

STEADY PERFORMANCE

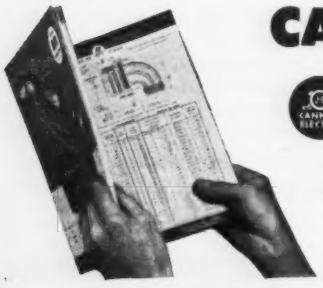
. . . AT ALL POINTS OF HIGH VIBRATION

This special vibration-proof Cannon Connector, because of its precision-built unit construction, is highly desirable for use on equipment which is subject to excessive vibration . . . such as the feathering governor, mounted behind the propeller.

The special type of Cannon Connector developed for use in this exposed position retains the coupling ring on the fitting by means of a phosphor bronze retaining ring designed in such a manner that permanency is assured. The barrel and the major portion of the shell are cast in one piece in order to withstand vibration.

This connector is just one of the many thousands of types made by Cannon for connecting and disconnecting electrical circuits quickly and with absolute certainty.

The Bulletin on Cannon Type AN Connectors . . . gives a complete explanation of construction and operation of AN plugs. 82 pages with ample illustrations. Address Dept. A-105, Cannon Electric Development Co., Los Angeles 31, Calif.



CANNON ELECTRIC

Cannon Electric Development Company
Los Angeles 31, California

Canadia. Factory and Engineering Office:
Cannon Electric Company, Limited • Toronto, Canada

now being manufactured under the trade name of the F. P. L. Toughness Testing Machine. The machine is said to disclose possible physical weakness in wood more accurately than by density and other physical property tests usually made in inspection for exacting uses of wood. It is claimed also that compression defects resulting from proud wood and decay, which might not be discovered by the usual inspection methods, can be revealed by the machine.

The toughness testing machine operates by a falling pendulum that breaks a wood specimen supported as a simple beam loaded in the middle. The machine has 15 different loading capacities and three speeds to rupture the specimen of wood being tested. Indications of the machine are converted into the number of inch-pounds of energy which are absorbed in breaking the specimen.

The machine must be used in conjunction with visual inspection to eliminate compression wood as well as diagonal and spiral grain. The Baldwin Locomotive Works, Baldwin-Southwark Division, Philadelphia, Pa.

Improvement in Drilling

A basic improvement in drilling machinable materials, employing a new device known as the Rego Karveit Driller, which is interchangeable with the conventional chuck, is reported to increase production greatly while using standard drilling machines. The device may be operated at handbook cutting speeds and feed rates with ordinary drills, and in drilling unusually deep holes in some materials, the drilling time may be reduced to about one-half the time required in conventional practice. Under this method, moreover, it is stated that cutting speeds may be increased as much as 25 per cent above handbook ratings, if desired. It is reported that holes as deep as 20 times the drill diameter are drilled by unskilled operators or with automatic feeds, without removing the drill from the holes.

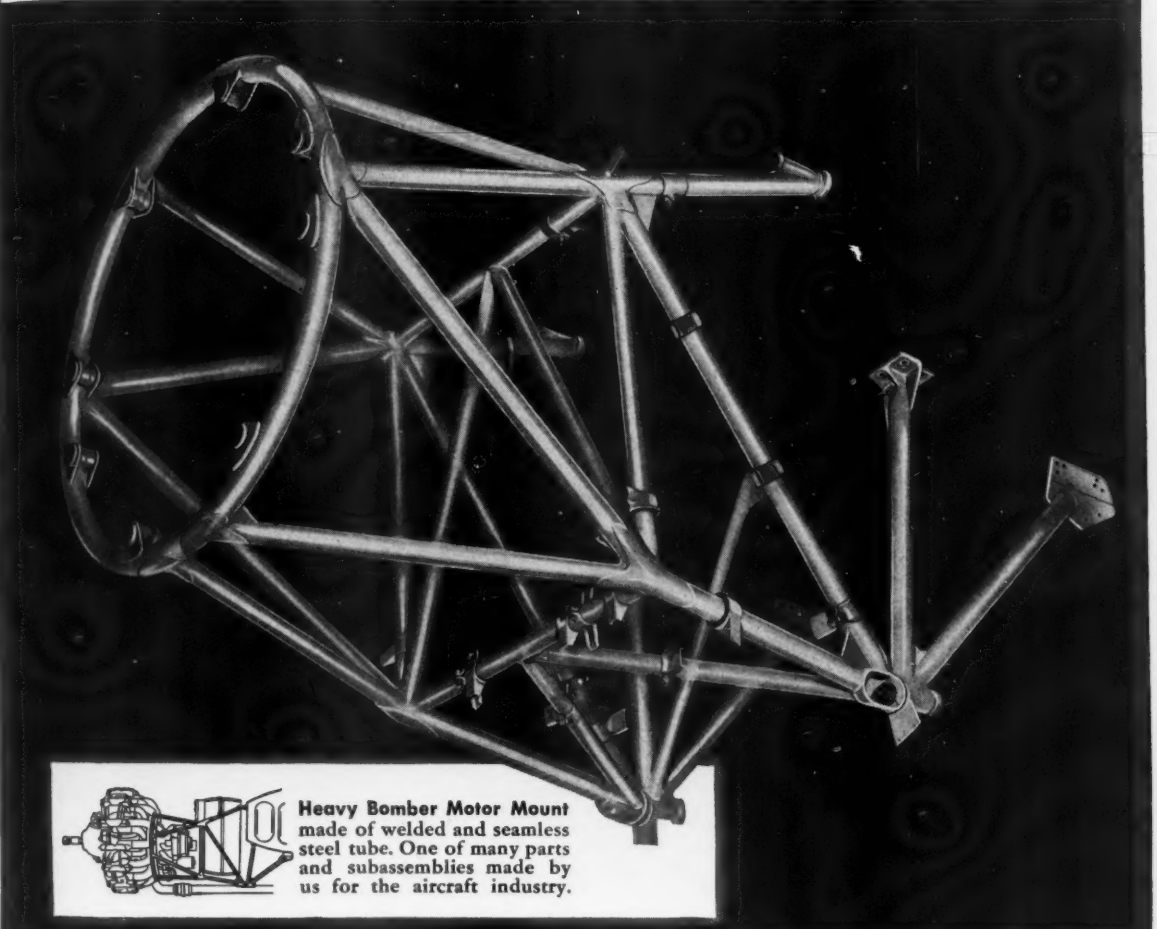
The makers state that the driller produces automatically, at the cutting edges of the drill, small uniform chips that clear the drill flutes easily instead of long, whipping spirals that score the side walls of the holes and sometimes injure operators. Surplus coolant or lubricant washes the chips away, and the lubricant serves as a coolant or to bathe both sides of the cutting edges of the drill at every revolution. Other advantages claimed are that drills can be used for a longer time without sharpening, rejects are substantially reduced, and injuries to operators and damage to equipment due to chips are practically eliminated. The Bastian-Blessing Company, Chicago, Ill.

Liquid Phenol-Formaldehyde Resin Glue

Cascophen LT-67 is one of the wartime glue developments, combining many of the desirable properties of phenol-resin, urea-resin, and casein glues. By the use of different catalysts, it can be adapted to assembly gluing

AMERICAN METAL PRODUCTS COMPANY

Manufacturers of Welded Steel Tube, Tubular Parts and Assemblies for the Aircraft Industry



Heavy Bomber Motor Mount made of welded and seamless steel tube. One of many parts and subassemblies made by us for the aircraft industry.

We are specialists in the quantity production of Chrome-Moly and carbon steel assemblies calling for upsetting, forming, swaging, forging, welding, heat treating and machining.

AMERICAN METAL PRODUCTS COMPANY, 5959 LINSDALE AVE., DETROIT, MICH.

Here's one Nazi broadcast that's the Gospel Truth!

U.S. TANK IS BEST, SAY NAZI EXPERTS

Germany Will Doubtless Copy Gyroscopic Feature of General Sherman Tank, Berlin Radio Declares

By The Associated Press

A special new German institute for testing captured tanks has adjudged the American "General Sherman" the best type the Allies have turned out, the Berlin radio said yesterday, adding that the Nazis "doubtless" would copy its construction—particularly the gyroscopic gun-mount, which they consider its outstanding feature.

"Doubtless" Best Type

"According to the findings of the Institute," said the broadcast, recorded by the Associated Press, "the 'General Sherman' tank is doubtless the best type the allied armament industry has yet produced.

"A special innovation on this type tank, which by a gyroscopic system prevents the gun from being affected by the jolting of the tank when traveling on rough grounds, greatly interested the German experts. They believe this to be the first attempt at borrowing from the construction of warships for the construction of arms for warfare on land, and doubtless it will be copied soon."

WHEN THE GERMAN RADIO paid glowing tribute to the General Sherman tank—for once it was telling the truth.

You see, tank battles used to be stop-and-go affairs, because a tank's heavy cannon could be aimed accurately *only when the tank was at a complete standstill.*

That was bad—because every stop naturally made the tank a juicy target for the enemy.

Then the Army Ordnance Department called on American industry for the solution of this problem. So the men of Westinghouse went into a huddle. And out of it came what has been called one of the greatest military developments of this War—a tank gun stabilizer that permits *incredibly accurate fire while the tank is charging ahead at full speed over rough ground!*

And then, to button up the job, Westinghouse went into production on these gun stabilizers so fast and so thoroughly that almost before you could say "El Alamein," they were being produced in sufficient quantity to equip every American tank!

No wonder the Germans thought well of the General Sherman. And no wonder they considered its gun stabilizer its outstanding feature. For this one device has revolutionized the whole combat technique of tank fighting!

For us, tank battles are no longer stop-and-go affairs, with every stop offering the enemy a "sitting pigeon." American tanks are now more than 500% deadlier than ever before.

And the Westinghouse Research Laboratories, which developed the device—the Westinghouse engineers, who perfected it—and the men and women of Westinghouse who make it in great numbers—are proud as Punch.

Westinghouse Electric & Manufacturing Company, Pittsburgh, Penn.

» » **Westinghouse** « «

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

(at warm storage), laminating, hot press gluing, or bag gluing, producing results of equal durability in each case. The glue is supplied as a water solution containing 65 to 67 per cent resin solids. It is used with separate catalysts M-18 or H-23, which are supplied in powder form to be mixed in the resin. For most work a suitable inert filler, supplied by the user, may be added.

The makers state that LT-67 produces a bond with typical phenol-resin durability. The bond is boilproof, moldproof, waterproof, and heatproof. It complies with Army-Navy Aeronautical Specification AN-NN-P-511b for aircraft flat plywood and with proposed Navy Bureau of Ships Specification 52G12 for intermediate temperature setting phenol-formaldehyde resin glue. The strength or durability of the bond is not affected by organic solvents such as alcohol, petroleum solvents, coal tar solvents, etc. It is moderately resistant to certain acids. Oxidizing agents such as nitric acid will, however, destroy the glue bond.

On low-density woods such as spruce, poplar, basswood, mahogany, and Douglas fir, Cascophen LT-67 can be cured and matured at a temperature as low as 70°F., attaining full strength and durability. Curing temperatures for hardwoods may be as low as 110°F. The glue can also be used at higher temperatures, up to 300°F. The neutral set film is obtained even at the lowest curing temperatures. Further technical information is contained in Technical Bulletin No. 104a. Casein Company of America, New York, N.Y.

Production Calculator

The Crobalt Production Calculator is a chart intended to simplify the calculations for machining operations. Problems for turning, drilling, boring, reaming, facing, and milling operations may be solved by drawing four straight lines across the chart. These charts are assembled into a pad so that after a problem has been solved the page may be torn out and filed with the blueprints or specifications for the job.

The chart has a wide range of specifications such as revolutions per minute, feeds, cutting time, etc., which cover the average types of machining operations. It enables the estimator to predict more accurately the production in pieces per hour. When it is used in this manner it should accompany the print to the shop to determine the machine setup and production for that job. This calculator may also be used by the engineering department to arrive at the greatest production or for the visual analysis of an operation that is not being run so efficiently as desired, as it will usually indicate where inefficiency of a tool setup exists. Another use for this chart is for the permanent record of the cutting conditions of a job in order to duplicate the setup on the same or a similar run at a later date. This may readily be done by drawing the existing conditions on the chart and filing it with the blueprint.

Some examples of the use of this chart include turning hot-rolled medium carbon steel with Crobalt single-point tools; drilling a 1-in. diameter hole through a 2-in. thick bar of medium carbon hot-rolled steel using high speed steel drills; face milling a 10-in. long block of medium cast iron (no scale) with an 8-in. diameter face mill having 20 inserted teeth made of Crobalt; and turning leaded brass with single-point Crobalt tools.

The production man using this chart should use his judgment in choosing the size of cut, the size and shape of the cutting tool, the type and size of machine, the cutting fluid used, etc. Allowances should be made for scale on the material cut, rigidity of the setup, and accuracy and surface finish desired. Free copies of the production calculator may be obtained from the makers. Crobalt, Inc., Ann Arbor, Mich.

Compound for Control of Airport Dust

A new compound has been developed for laying airport dust which is described as a stable homogeneous liquid of relatively low viscosity which may be diluted or extended with water in all proportions. The concentrate and its emulsions are claimed to be effective in wetting and penetrating over all types of soil, including moist earth. It is stated that the compound may be actually applied to a soft, muddy surface immediately following a rain. Because of a new type of emulsifier used, the oil will wet only the top 2 in. of the soil since it becomes water insoluble on further penetration.

For this reason the composition is not dissolved and leached away into the soil by a following heavy rain. It is also stated to be safe and easy to handle, to be noncorrosive to metal and spray equipment, and to contain an effective weed killer. Curran Corporation, Malden, Mass.

Individual Safety Booths for Workers

A series of specially designed booths perfected over a period of years for the safety and comfort of workers handling difficult and dangerous propeller finishing operations have been installed in New Jersey plants of the Propeller Division of Curtiss-Wright Corporation. Nineteen of the new "safety booths" are now in operation.

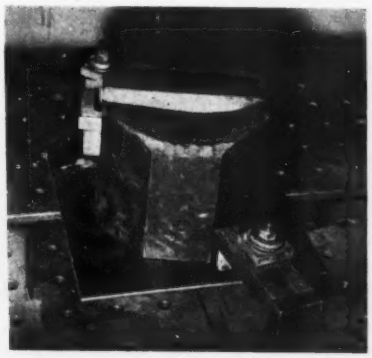
The individual safety booths, arranged in series with one operator to each unit, are air conditioned to carry off harmful dust particles, lessen workers' fatigue by cutting down noisy grinding operations, and practically eliminate hazards created by flying pieces of metal. The units, installed exclusively for grinding and polishing operations on hollow steel blades, are built of Thermax, which is a nonpriority, noncombustible material. Each booth is lighted by two 20-watt fluorescent lamps designed to reduce eyestrain. A fan unit is installed at the rear of each booth to carry off dust and small injurious metal particles, while lager pieces of steel are thrown into a salvage hopper below. Passing workers are protected from flying particles by a baffle extending 6 in. from the interior of each booth.

Propeller Division officials claim the new safety booths have decreased the loss of man-hours through accidents and resulted in a speed-up in production. Curtiss-Wright Corporation.

Plastic Metal Punch and Noncritical Metal Die

A test run by which several hundred sheet metal airplane parts were formed on a drop hammer equipped with a newly developed type of all-plastic punch and noncritical metal die has been completed.

It is stated that the punch and its component die can be produced at a saving of at least 75 per cent of the tooling labor required to build a similar all-metal die and with conservation of critical war materials. The plastic used in the punch is a refinement of other types of plastics used in earlier experiments, while the lower die is made of a metal called "Kirksite" which was developed to relieve the demand for critical tool steels.



The new type plastic punch developed in a Buffalo plant of Curtiss-Wright Corporation is perfectly mated to the dye in a single operation, thus saving machining necessary on all-metal types.

Capable of becoming malleable when heat-treated, the punch saves three-quarters the time formerly spent in tooling because it can be shaped into a perfect fit with the die in a single operation. The die is heated to approximately 370°F., and the plastic punch, roughly shaped for mating contours, is placed on the hot die and pressed into it. This pressure forces the plastic to flow into the heated die and produces an exact match punch without benefit of any machining operation.

Another feature of the new punch is the elimination of the use of rubber pads and strips to absorb shock and protect metal surfaces. The plastic nature of the punch absorbs all shock and allows the sheet metal part to be formed with fewer blows. As the punch wears it may be "dressed" by

simply heating the "Kirksite" die and again pressing the plastic punch into it. All used punches are reclaimable so that there is no waste. Curtiss-Wright Corporation.

"Zip" Method to Remove Seals from Warplane Tubing

A fast method of freeing the airtight sealed ends of hydraulic tubing has been developed to speed production of Curtiss Helldiver (SB2C-1) dive bombers while eliminating a former irritating problem on the assembly lines.

The new technique of removing tough seals from tubing ends was devised by the adoption of the cellophane-wrapper zipping principle, by placing a string underneath the seals before covering. Now, by means of a quick pull, a worker on final assembly can free the tube end, making it instantly ready for installation on a dive bomber.

By the former system, workers had to pry the coverings off by using a fingernail, knife, or metal tool, which involved a loss of time, possibly marred threads, and permitted foreign objects to fall into the tubing. The protective seals are applied wet and when dry each hardens and forms an airtight seal. The idea, brought to light through the plant's employee suggestion system, has been applied to all other plants of the corporation's Airplane Division. Curtiss-Wright Corporation.

Equipment for Testing Military Aircraft Accessories

Special equipment and fixtures for testing the proper functioning of airplane accessories before they are installed in military aircraft replace the former procedure of testing accessories after they have been installed in warplanes, thus effecting savings of time and materials. The previous method required the use of skilled mechanics and technicians for engine and electrical units, as well as a large amount of airplane-engine operation. Now all accessories are checked first on the special equipment.

Under what is known as the "preset" system, in which aircraft accessories are set to the correct limits before becoming a part of the military plane, operators who are entirely unfamiliar with this type of equipment may be trained to test these parts on the new fixtures in a limited time. Each fixture consists of a cabinet and appropriate panels fitted with the necessary equipment, gauges, or electrical instruments to perform a fixed check on one unit or related units. The fixture functions automatically, so far as possible, and is arranged so that units cannot be improperly connected.

On these fixtures the accessories are held in an easily accessible position where they may be quickly checked and adjusted under operating loads without marring any part. Whether the unit is preset or only checked, defective units will be caught immediately. Work on accessories is done in a special crib restricted to operating personnel and designed to check government-furnished equipment, issue it to the shop, and keep accurate check on quantities and rejects.

Releases are printed as received from companies and other aeronautical organizations and the responsibility for the accuracy of all statements is therefore not assumed by the Aeronautical Engineering Review.

In this plant it has been the practice to preset fuel pumps, generator relays, voltage regulators, propeller governors, fuel-oil-and-vacuum-pressure warning units, booster coils, and fuel-level gauges. The plant also checks the proper operation of starter and battery solenoids, hydraulic pumps, vacuum pumps, generators, fuel analyzers and indicators, flap and landing gear position transmitters and indicators, radio assemblies, fluorescent lights and inverters, and outside-air and carburetor-inlet air temperature bulbs and indicators.

An example of time saved by this method in presetting the generator voltage regulator for a warplane is the fact that 1 hour per plane was required to perform this function under engine power Today a regulator unit is checked and set in 20 min. without any engine run or further adjustment after installation. Curtiss-Wright Corporation.

New Welding Shield

The makers now have ready for immediate delivery new models of Huntsman acetylene- and arc-welding shields. These new shields embody a number of exclusive features. Designed by a welder, the shield has a patented locking device and comfortable, easily adjustable headgear. The locking device holds the shield in the correct position before the face to assure that the line of vision passes through the lens at right angles to the surface of the glass. It also holds the shield firmly above the head while the welder is preparing, chipping, or surveying his work. When welding must be resumed, a slight nod of the head lowers the shield into the correct working position. The locking device automatically adjusts the shield to the same position each time.

Huntsman shields range in weight from 1 to $1^1/_2$ lbs. and are available from stock in six models. Davis Emergency Equipment Corporation, Newark, N.J.

Hook Checker for Thread Milling Cutters

A universal hook checker designed to enable rapid, accurate checking of hook or rake angles and flute spacing in sharpening thread milling cutters has been announced.

Visual aligning of a ground straight edge with the face of the cutter flute—against an illuminated background—permits the operator to read the offset distance directly from an integral micrometer barrel. Simple placement of an indicator finger against the cutting face enables any error of flute spacing to be read directly on an indicator dial.

The machine consists of three principal components: a base mounted on a pedestal, an adjustable cutter mount with a dual head—one for hook and one for space checking—and the hook and flute spacing measuring assembly. The lower cutter mounting center is fixed to the base. Upper mounting centers are attached to a support that is adjustable vertically to accommodate various lengths of shank-type or shell-type cutters with arbors.

The measuring assembly in which the ground straight-edge finger and the indicator are mounted is provided with a vertical adjustment controlled by a hand wheel. The two micrometer barrels that control the movement of the straight edge for right- and left-hand offsets, respectively, are calibrated to measure the offset distance from a radial line. Directly beneath the straight edge is a diffusing glass background illuminated by a lamp in the base. The spacing indicator and its finger are positioned to measure any error of cutting face spacing by comparison with the spacing of a master index plate. Detroit Tap & Tool Company, Detroit, Mich.

Spray-Degreasing Booth

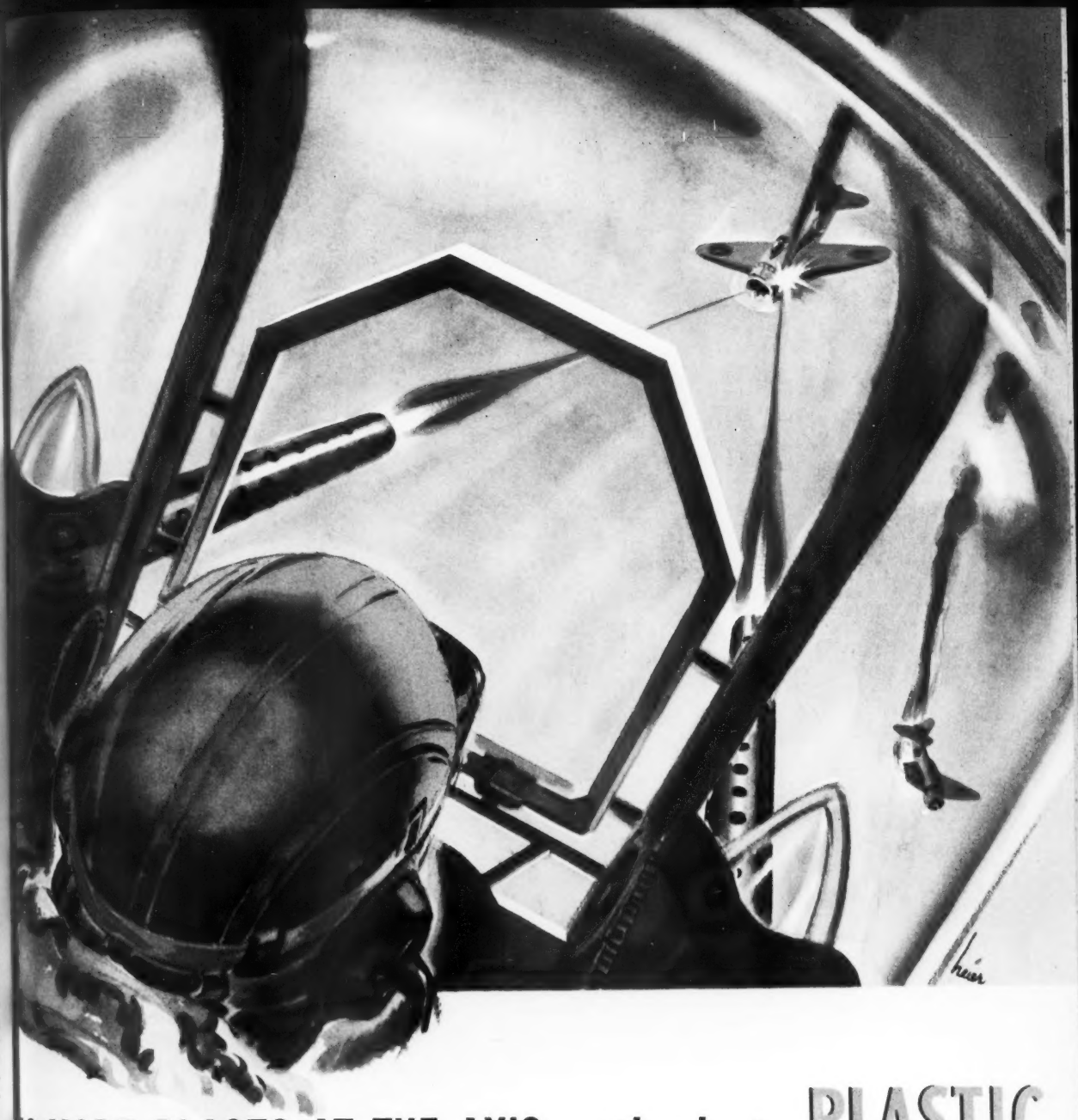
In view of the shortage of organic solvents of the type used in degreasing operations, one of the most important of the advantages claimed for a new spray-degreasing booth is the ability to hold solvent loss to a minimum. Designed for safe operation, even when hazardous materials of high volatility and low flash point are used, the new unit is claimed to remove fumes thoroughly and to deliver a forceful, hard-driving solvent spray.

The booth is made in 14-, 16-, 18-gauge steel. Sizes vary according to the requirements of the products to be handled. The De Vilbiss Company, Toledo, O.

Airplane Jack

A mechanical wing jack for servicing and repairing airplane landing gears and for other undercarriage work has been developed. Designed for easy portability, the SK-1410 jack is equipped with a collapsible tripod that is folded down for convenient storage in planes. Special hinge stops maintain tripod rigidity under the load.

This new airplane jack will carry loads up to 18 tons and is built for continuous heavy duty. Its closed height is 44 in. and, with a raise of 32 in., it extends to 76 in. The large bearing surface of the legs of the SK-1410 makes the jack suitable for use on soft clay.



46 MORE BLASTS AT THE AXIS . . . *thanks to* PLASTIC

Fifteen pounds saved may not seem like very much to you—but to a turret gunner, it makes possible 46 extra rounds of .50 caliber ammunition which could mean the difference between Victory for him—or the Axis gunner.

In today's combat aircraft, every pound saved can be translated into terms of more fire-power, or extra gas, or added speed. That's why plastic is contributing so much to aircraft efficiency.

In a recent application of this strong light-weight material to power-driven gun turret parts, a saving of 32% in weight was achieved through the use of *Structo-mold, a *laminated-paper* plastic developed by McDonnell.

This type of plastic is particularly adaptable to fabrication in the specialized shapes necessary for turret parts such as gun shield, gunner's seat, canopy door, step, and gunner's floor assemblies; also gun fairing, and apron and skirt assemblies. Equally as strong as those made of metal, plastic parts cost *less* to manufacture.

We shall welcome inquiries regarding the production of aircraft parts such as *gun turret assemblies;* also *ammunition boxes,* and *helicopter rotor blades.* Please address all inquiries to our PLASTICS DIVISION.

*Reg. U. S. Pat. Off.

McDONNELL *Aircraft Corporation*

Manufacturers of PLANES · PARTS · PLASTICS ★ SAINT LOUIS - MEMPHIS ★

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Under high pressure, all thermoplastics deform. With PLEXIGLAS, *this deformation, called cold flow, is small. Data on how it varies with temperature, pressure, time, and pre-conditioning is included in the* PLEXIGLAS Mechanical Properties *Manual.*

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THE CRYSTAL-CLEAR ACRYLIC PLASTICS

PLEXIGLAS
SHEETS AND RODS

★

CRYSTALITE
MOLDING POWDER

PLEXIGLAS *and* CRYSTALITE *are the trade-marks, Reg. U. S. Pat. Off., for the acrylic resin thermoplastics manufactured by Rohm & Haas Company.*

ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA, PA.

Manufacturers of Chemicals including Plastics . . . Synthetic Insecticides . . . Fungicides . . . Enzymes . . . Chemicals for the Leather, Textile and other Industries

It may be readily rolled from one place to another by means of 6-in. diameter wheels. The Duff-Norton Manufacturing Company, Pittsburgh, Pa.

Nylon for Warplane Tires

The first quantity shipment of high-strength Nylon yarn was made recently from the du Pont company's plant to six tire and rubber companies, and shipments are to increase until the total by the end of the year reaches 750,000 lbs. of yarn.

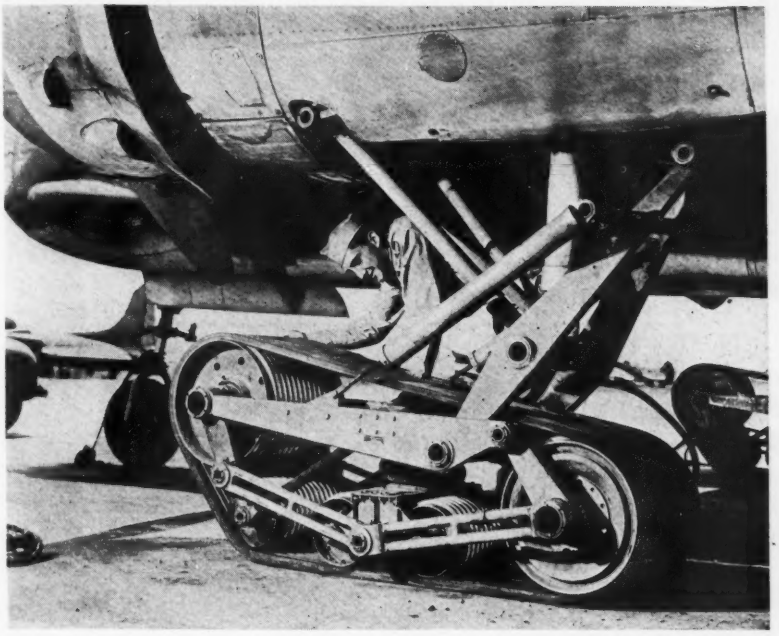
Four dozen of the first Nylon tires were sent for test to Wright Field and were placed on bombers of the type giving the greatest tire trouble. A number of planes ordered to the Pacific war zone were equipped with Nylons. Since that time small amounts of yarn have been going to each of five rubber companies so that they could acquire experience in established manufacturing techniques. Heavier loads ordinarily call for tires of larger dimensions, but these could not be installed without redesigning the landing gear and the recesses into which the wheels retract in flight. The problem thus was to obtain more strength without adding to the bulk of the tire, and Nylon provided the answer to the problem.

Some of the first Nylon cord tires will be for the tail wheels, where tire failures have been experienced with the fabrics now being used. Large landing-gear tires will also be made, and the allocations are for pursuit and cargo planes as well as for bombers. E. I. du Pont de Nemours & Company (Inc.).

Improved "Doping" Method

Acceleration of 20 to 30 per cent in the process of "doping" the cloth that covers airplane and glider surfaces is reported from the use of predoped fabric and a new "high-solvency" type of lacquer. Savings in time and labor accomplished by the new materials are stated to increase subassembly rates substantially. Previous procedure called for stretching untreated cloth over sections of aircraft framework and applying dope with brush and spraygun—interrupted by laborious sanding—through eight separate operations. Now all hand brushing is eliminated and the total number of coats is reduced with consequent saving in drying time. Aircraft-plant floor space is more rapidly freed for use.

A method was developed for lightly pretreating fabric before shipment to aircraft factories, which also permits saving valuable solvents for reuse. In addition, much of the work of sanding to smooth surfaces is eliminated. The specially developed method of predoping allows retention of the pliability and tautening properties of the untreated fabric, with resultant ease of tailoring and satisfactory performance. Second, the laboratories produced a "high-solvency" lacquer or dope containing 20 per cent more film-forming solids than this type of finish ever before contained for practical usage. Consequently, slow paint-brush work is replaced by high-speed spraying. E. I. du Pont de Nemours & Company (Inc.)



Official Photograph U.S. Army Air Forces

Applying the principal of wide tracks, similar to those used on tanks, planes can now be landed on rough terrain at relatively high speeds. This new type landing gear was developed by The Firestone Tire & Rubber Company in cooperation with the U.S. Army Aircraft Laboratory and the Dowty Equipment Company. The new tread uses approximately the same amount of rubber that goes into a regulation landing tire.

Gyro Testing Device

A mechanical testing device that reduces the time required to test gyroscope rotors from 3 hours to a few minutes makes possible the use of comparatively newly trained help, thereby freeing the skilled technicians who formerly tested rotors by hand for important research and development work.

The testing device includes a "sparking eye," which scans a gyro-rotor spinning at high speed and marks, through an electric current, the points of unbalance. The device simultaneously records the exact amount of weight necessary to be drilled from the rotor to bring it into perfect balance. Eclipse-Pioneer Division of Bendix Aviation Corporation.

Landing on Soft Ground, Rough Terrain, or Deep Sand

A caterpillar type landing gear for aircraft, similar to the tracks used on tanks, has been developed by engineers of the manufacturer in cooperation with Army Aircraft Laboratory and is going through intensive tests at Wright Field. This landing gear is expected to facilitate landing on soft ground, rough terrain, or deep sand.

The track incorporates a suspension that keeps impacts from being too severe at any one point of contact, whether this contact is between tread and ground or between bogie wheels and belt. Because the landing area is wider and flatter, planes of all types will be able to land on rough ground. In describing the tread, the company states that with the same amount of rubber that goes into a regulation landing tire, the new tread gives the plane four to eight times the area of contact on the ground.

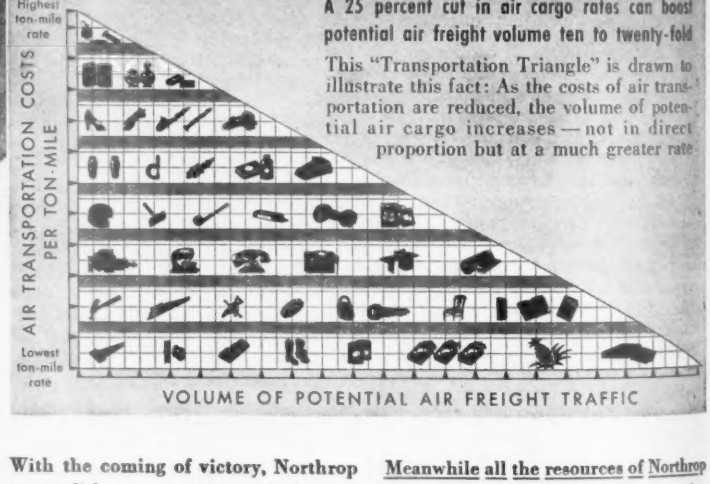
The new gear is constructed with steel bracing and grooved aluminum bogie rollers. The rubber track has a wire beading on the edges and also is grooved to fit into the roller grooves, thus preventing side slippage. An air spring, conserving space and weight, is used for partial cushioning of the landing impact. Firestone Tire & Rubber Company.

To Facilitate Blade Balancing

Production of propellers has been accelerated in a Frigidaire plant through the use of a transparent plastic shield to guard propeller blades from drafts of air during delicate balancing operations. Formerly, the balancing test had to be made by removing the blade from the grinding bench and taking it into a special enclosed room in which there were no air drafts. Since the operator had to make this test frequently to make sure that he was not grinding off too much metal, time was wasted which could be saved if the balancing could be done on the grinding bench. The problem was to prevent air drafts from striking the surface of the blade.

The answer was found when Frigidaire engineers developed the special transparent protective shield—which effectively prevents air drafts from striking the blade and, at the same time, permits the operator to see the position in which the blade finally comes to rest.

PREDICTION: Postwar freight will fly ...at less than 15 cents a ton-mile


Highest ton-mile rate
AIR TRANSPORTATION COSTS PER TON-MILE
Lowest ton-mile rate
VOLUME OF POTENTIAL AIR FREIGHT TRAFFIC

A 25 percent cut in air cargo rates can boost potential air freight volume ten to twenty-fold

This "Transportation Triangle" is drawn to illustrate this fact: As the costs of air transportation are reduced, the volume of potential air cargo increases — not in direct proportion but at a much greater rate

AFTER VICTORY looms one certainty: Out of America's war-accelerated research will come new and different airplanes for a world at peace.

Airplanes so advanced as to make obsolete the newest and largest transports in the skies today.

Planes of new, unorthodox design—capable of carrying larger loads longer distances with greater economy in operating costs.

Giant land and seaplanes. "Shuttle" craft for short hauls. Express planes of incredible speed.

In these airplanes America's postwar products and American technicians will have the means to go fast and far to markets anywhere on earth—to unlock the world's commerce—and create new horizons for the better material welfare of us all.

Knowledge U.S. aircraft designers already possess is enough to guarantee this prophecy. For aircraft now on drawing boards can be operated profitably at rates below 15 cents per ton-mile. The rates for air freight before the war were from 80 to 90 cents per ton-mile!

With the coming of victory, Northrop accomplishments, together with those of other U.S. leaders, will contribute to a new world of peace and opportunity. A more desirable world in which to live.

Meanwhile all the resources of Northrop in plane design and plane construction are devoted solely to producing the planes of war. The planes that bring closer the day of complete victory for the Allies.

NORTHROP *Aircraft, Inc.*

NORTHROP FIELD, HAWTHORNE, CALIFORNIA

MEMBER AIRCRAFT WAR PRODUCTION COUNCIL, INC.

As a result, the time required for an operator to check the balance of the blade he is grinding has been reduced to a matter of seconds.

The new device has worked so well on the blade grinding benches that it is also being used in the final inspection of propeller blades, in which teams of men and women double check the balance of the blades before they are assembled into the finished propellers. Frigidaire Division of General Motors Corporation.

Single-Phase to Three-Phase Transformer

A single-phase to three-phase transformer for the operation of gyro instruments on aircraft equipped with a 400-cycle, 115-volt, single-phase inverter has been introduced.

This transformer has been designed specifically for the simultaneous operation of one G-E Type KB-1 (gyro-horizon) and one Type KC-1 (directional gyro) instrument and will not operate any other load efficiently. The transformer provides the three-phase supply necessary for the operation of the instrument from the single-phase input provided by the inverter and brings the gyro motor up to full speed in $1^1/_2$ min. at normal temperature (25° C.). Measuring $2^{11}/_{16}$ by $2^3/_8$ by $2^1/_{16}$ in. and weighing 8 oz., the transformer meets the requirements of the U.S. Army Air Forces. General Electric Company.

Starting Vibrator for Aircraft-Engine Ignition

A starting vibrator especially designed to provide positive and instant ignition for aircraft engines, regardless of prevailing weather conditions and low magneto speed, has been announced. This vibrator applies a pulsating, low-voltage current directly to the low-voltage winding of the aircraft magneto, 1.8 amperes at 24 volts, d.c.

By transformer action within the magneto this low-voltage input is stepped up to provide a high-voltage output which facilitates instant ignition of the aircraft engine.

Power losses are reduced by application of the low-voltage current direct to the magneto. Special design features assure almost complete elimination of radio interference. The vibrator operates only during the starting cycle. It is then automatically disconnected from the ignition circuit. General Electric Company.

Rapid-Heating Rivet Gun

A rapid-heating explosive-rivet gun has been developed. The gun is claimed to be light, portable, inexpensive, and easy to handle. Its principle involves the passing of a low voltage and high current through two conducting leads terminating in a high-resistance metal tip. Resistance of the tip causes a high temperature over its restricted area.

Operation of the gun is described as follows: The riveter holds the rivet in place with gun and squeezes the trigger.

The Goodyear Aircraft Corporation's rapid-heating explosive-rivet gun.

This closes the circuit causing the tip to heat almost instantly. When the rivet is detonated, the trigger is released and the operation is repeated on the next rivet. Rapid radiation results in a speedy cooling of the tip. Goodyear Aircraft Corporation.

Series No. 900 Pilot Lights

Gothard Series No. 900 pilot lights are designed for grounded pilot-light panels. Measuring approximately 2 in. in length, they mount on 1-in. centers, permitting a number of units to be incorporated within a small space. Body of hexagon design facilitates the use of a socket wrench in installation. Bulb change is accomplished from the front of the panel without disturbing body mounting or wiring. The bulb automatically comes out when the jewel holder is unscrewed. Bayonet socket lamps (long or round) may be used. The unit is available with either faceted or plain jewels. Gothard Manufacturing Company, Springfield, Ill.

Resin Added as Winter Resistant for Concrete

Highways and concrete runways on airplane landing fields have been made resistant to severe winter conditions through the addition of about a tablespoon of Vinsol, a pine wood resin, to each sack of cement. This development resulted from 5 years of effort to find a way to eliminate surface scale caused by freezing, thawing, and applications of salt for ice removal, by chemists of Hercules Powder Company in cooperation with various state highway departments, Federal agencies, and the Portland Cement Association. Fractional amounts, ranging from $2^1/_2$ to $4^1/_2$ parts in 10,000, of the resin are added by cement manufacturers to the clinker during grinding. The resin is extracted from southern pine wood.

Test roads, on which strips of resin-treated portland cement concrete were laid side by side with untreated concrete, show that where the strip of untreated concrete has deterioratd due to winter conditions, the section of resin-treated cement concrete alongside it remains unaffected. Laboratory tests show that in all cases this resin-treated portland cement has superior resistance to freezing, thawing, and applications of chloride salts.

Vinsol-treated cement has also been used extensively by the U.S. Corps of of Engineers for numerous jobs, principally in the construction of military airports throughout New England, New York, Michigan, and Illinois. Vinsol-treated portland cement is recognized in the specifications of the American Society for Testing Materials, and by the Federal Government. Over a year and a half ago, Hercules dedicated to public use all patents covering the use of Vinsol resin in cement, without payment of royalties. Hercules Powder Company, Wilmington, Del.

Synthetic Hose Needs No Reinforcement or Cover

According to an announcement by the maker, Hycar synthetic rubber hose will withstand long and hard usage carrying petroleum products and other solvents in low-pressure service. The Hycar hose can be made in one operation by the extrusion method in lengths as long as desired. The process of wrapping and covering the tube would not be necessary.

For gravity and low-pressure feeds of petroleum products, this oil-resistant synthetic could solve many formerly perplexing problems. It is stated to be little affected by temperatures as low as −70°F. and does not crack or disintegrate under intense sunlight or heat. It is recommended by the makers for flexible couplings on oil or other solvent-carrying lines. Hycar Chemical Company, Akron, O.

Wind Indicators

The Kenyon Model KA2 anemometer is designed to provide a constant indication of wind velocity, shown in miles per hour, on a dial which may be located anywhere, indoors or out. The Kenyon wind-direction indicator gives information on the direction of the wind on a similar dial. Each of the instruments is composed of three units, a transmitter, located outdoors; a dial; and a calibration panel, which controls the operation of the instrument.

Power for the wind-direction indicator is provided by a single No. 6 dry-cell battery. In the anemometer the battery is eliminated through the introduction of a small generator in the head of the transmitter. The operation of both instruments has been reduced to the simplest formula. The calibration panels and the dials of both instruments are practically the same with the exception of the readings on the dials. The anemometer dial has a graduated scale calibrated for wind velocities from 0 to 60 m.p.h. The wind-direction indicator's dial is marked with compass points and degrees. North is located at each end of an arc, with south in the center at

WILL POSTWAR AIRLINERS FLY THESE LEVELS?

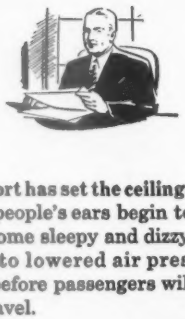
30,000 FEET

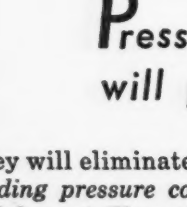
25,000 FEET

20,000 FEET

15,000 FEET

"It's something airline operators are looking forward to." Flying the higher altitudes will step up speed... cut fuel consumption... make possible smoother flights above storm conditions.

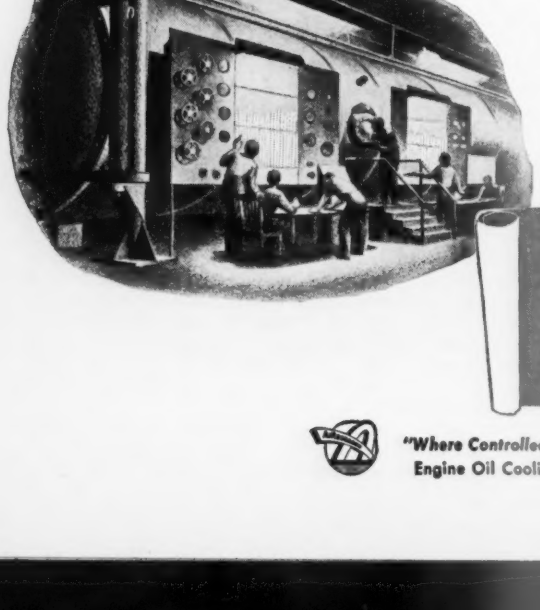




Up to now, passenger comfort has set the ceiling. For above 8,000 feet, most people's ears begin to pop. Above 10,000, they become sleepy and dizzy. These discomforts—due to lowered air pressures—must be overcome before passengers will take to high-altitude air travel.

Pressurized cabins will pave the way

They will eliminate these discomforts by *holding pressure constant* during take-off and descent. They will *adjust pressure* gradually during flight from low to higher altitude airports. They will even be able to hold sea-level altitude in the cabin while the airplane flies thousands of feet higher.



MUCH of the development work on cabin pressure control has been carried on here in the AiResearch "Stratolab". Our engineers have created altitudes as high as 65,000 feet—temperatures below minus 90° F. And they've found ways to control them!

The success of their engineering now assures pressurized cabins for postwar airlines. Information is available to aircraft manufacturers and airline executives.

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"Where Controlled Air Does the Job" • Automatic Exit Flap Control Systems • Engine Coolant Systems
Engine Oil Cooling Systems • Engine Air Intercooling Systems • Supercharger Aftercooling Systems

the bottom of the dial. East and west lie midway between these points. The dials are encased in polished chrome cast bronze and are hermetically sealed against moisture. The panels contain the operating switch, a calibrating device, and a simple switch by which the accuracy of the instruments can be checked.

The principal difference in the construction of these two instruments is in the transmitter units, which perform entirely different functions. The anemometer transmitter consists of a conventional three-cup rotor with a diameter of 18½ in., mounted on double, permanently lubricated, ball bearings. The rotor is devoid of gears or other mechanisms that would cause friction. The transmitter is supported on a 6-in. tube, and a mast bracket or flat base mounting is used as a support for the tube. For special mountings larger tubes are furnished. The entire assembly, with the exception of the bearings and rotor shaft, is made of Duralumin, and the total weight of the transmitter is 11 oz.

The transmitter on the wind-direction indicator is housed in a cast aluminum-alloy barrel, mounted in the same fashion as the transmitter of the anemometer. The upper housing carries a rotatable vane supported on a shaft mounted in ball bearings. A continuously wound resistor is housed in the transmitter and is connected to the dial by a single, three-wire, rubber-covered cable. The total weight of the transmitter assembly is 24 oz.

The accuracy of the Kenyon anemometer is claimed by the maker to be within 2 per cent, and the wind-direction indicator is accurate to within one point. Kenyon Instrument Company, Inc., Huntington Station, N.Y.

Airplane Landing Gear

It is announced that a new type of leaf spring landing gear has been drop-tested, flight-tested, and approved by the Army Air Forces Matériel Center at Wright Field for use on PT-12 and PT-17 training planes.

Resembling the landing gear of a bird, the claimed simplicity of the leaf spring landing gear makes it easy to manufacture. Made from flat steel plate stock—cut to shape, drilled, and bent to form—it is said to be cheaper to construct than the present strut and saves many hours of production time. Leaf spring tail sprags are already in general use on many small airplanes.

While it might be thought that the absence of recoil snubbers would cause a plane using this new type of landing gear to rebound upon being landed, quite the reverse is stated to be the case. When the wheels hit the ground, the spring landing gear spreads out and the sidewise motion of the tires upon the ground absorbs the recoil.

It is reported that Wright Field pilots, who have tested the spring gear, judge it satisfactory as a landing gear for use on planes of this type. The spring gear is claimed to be particularly good for fast, taxiing turns; to be softer in taxiing and less stiff when dropped in for a hard landing; to be without rebound tendency when the plane is landed on hard, dry surfaces; and to show a negligible amount of rebound when landings are made on wet grass or ice. In take-offs, it is stated there is no apparent difference from other types of gear installations. Leaf Spring Institute, Detroit, Mich.

New Laboratory Furnaces

A line of laboratory furnaces, new in appearance and construction, includes such types as the Box Furnace for drying precipitates, ash determinations, fusions, ignitions, etc.; the Combustion Tube for carbon determination, standard combustion, organic analysis, etc.; the Crucible Furnace for melting base metals, thermocouple calibrations, molten salt baths, etc.; and Hot Plates for heating, distilling, boiling, evaporating, etc.

The new furnaces are patterned, in many respects, after the production furnaces long made by Lindberg. They incorporate such features as the door-operating mechanism on the box furnace, which permits cooler working conditions; low-voltage, high-temperature type heating elements; the use of a Lindberg input control for smooth, "stepless" apportioning of heat; and the streamlined shape which matches other modern laboratory equipment. The furnaces are available in different sizes for operation on 110- or 220-volt a.c. or d.c. Lindberg Engineering Company, Chicago, Ill.

Reflecting Signal Device

The Littelfuse Signalette is a signal indicator for aircraft and other services where signals by light are used. No incandescent lamp is required. Signal indication is activated by reflected light, by visible light within or without the aircraft or other service, by daylight, or by "black light." It is radioactive. The signal is reflected by radium-active fluorescent paint. The indicator is claimed to operate under all conditions of light and also in total darkness.

The body of the Signalette houses a solenoid, the armature of which is connected by a simple hook-up with the two vanes of an opening and closing "butterfly." When electrically energized the fluorescent "butterfly" opens instantly to show signals. The reflecting member is furnished in red, amber, green, or white. When not energized the device shows black under all conditions. Littelfuse Incorporated, El Monte, Calif.

Quick-Change Gear Lathe

The Logan No. 820 Quick-Change Gear Lathe is recommended by the makers for work in which frequent changes in operating feeds must be made. It is claimed to be so simple and "foolproof" in operation that even inexperienced workers quickly learn its operation. The box provides 48 threads and feeds in either direction to the carriage of the lathe. By simple adjustment of its two levers, screw threads from 8 to 224 per in. are quickly available, and, by changing the 24-tooth stud gear for the 48-tooth stud gear furnished with the lathe, additional threads from 4 to 7 per in. are available. Similarly, longitudinal power feeds from 0.0015 to 0.1000 in. per revolution on the spindle may be obtained. Power cross feeds are 0.25 times the longitudinal feeds. The index plate which guides the operator in gear changing is legibly marked.

A feature is the automatic apron that operates from a spline in the lead screw through a worm drive and friction clutch for both longitudinal and cross feeds. For cutting threads an additional longitudinal drive operates from half nuts on the lead screw. An important safety feature, especially for inexperienced operators, makes it impossible to engage both drives at the same time.

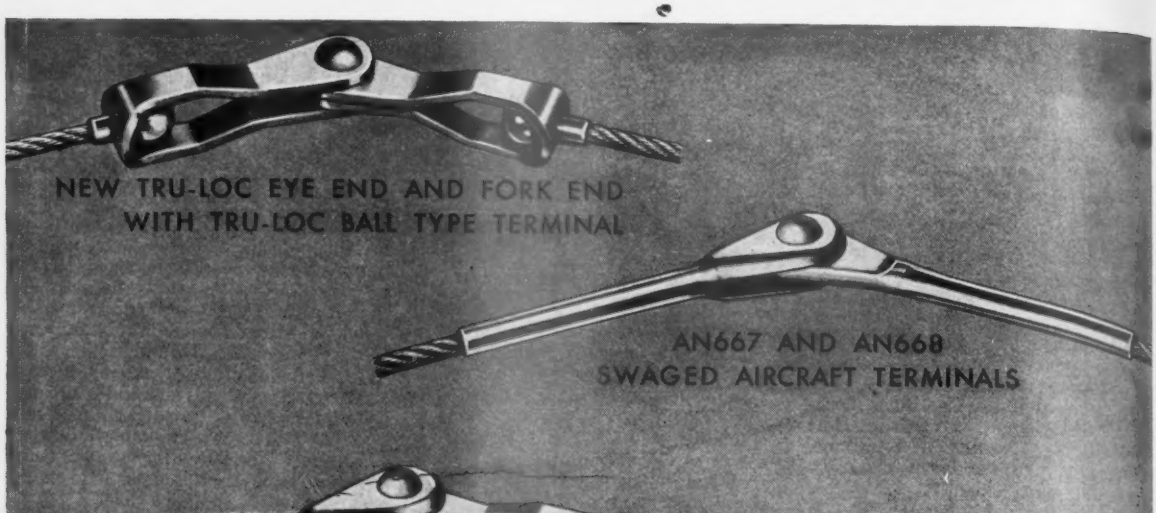
Other features claimed to assure the required accuracy for fine precision work, include "preloaded" ball-bearing headstock, which provides sustained spindle accuracy; patented three-point suspension of countershaft, which eliminates vibration even at high speeds; and a heavy, well-ribbed bed with precision ground V and flat ways. The swing over the bed in. the No. 820 Lathe is 10½ in. The bed length is 43⅛ in. and the distance between centers is 24 in. Logan Engineering Company, Chicago, Ill.

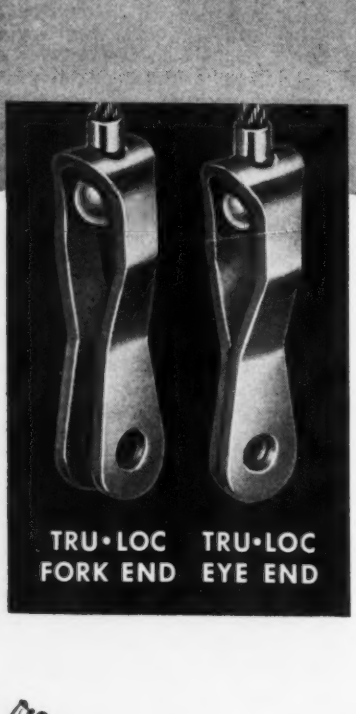
Plastic Flooring for Airplanes

A new lightweight plastic aircraft flooring is made from laminated phenolic sheet reinforced with aluminum-alloy strips and weighs approximately ¼ lb. per sq.ft. less than other types of flooring of equal strength and carrying capacity.

The need for a new lightweight flooring to cut down poundage on the super flying boats of the future was recognized by Martin designers back in 1941 when the problem of developing a plastic substitute for the corrugated aluminum flooring then in use was begun. The laminated phenolic construction now known as Panelyte re-enforced flooring resulted, and suitable dies and manufacturing techniques for producing this flooring in quantity were developed. In external appearance Panelyte flooring closely resembles the standard aluminum decking now used by the aircraft industry, and no special procedures or bracing are required for its installaton. It is laid on transverse frames 10 to 20 in. apart and is attached to these frames with Dzus or other standard fasteners, rivets, or bolts.

The top or load surface is a laminated, molded phenolic sheet and can be made with either a nonskid Morocco surface for flooring use or with a smooth finish for table tops and similar applications in airplanes. The laminated top sheet is molded onto a corrugated base made from phenolic-impregnated fabric, with an aluminum-alloy insert integrally molded into the lower horizontal surface.


NEW TRU-LOC EYE END AND FORK END
WITH TRU-LOC BALL TYPE TERMINAL
AN667 AND AN668
SWAGED AIRCRAFT TERMINALS
NEW TRU-LOC EYE END USED WITH
AN667 SWAGED TERMINAL
NEW TRU-LOC FORK END USED WITH
AN668 SWAGED TERMINAL



YOU CAN GET EARLY DELIVERY OF THESE NEW **TRU-LOC** FORK END AND EYE END TERMINALS . . . THEIR USE CALLS FOR NO CHANGES IN ENGINEERING BECAUSE THESE NEW **TRU-LOC** TERMINALS ARE PRECISELY INTERCHANGEABLE WITH AN667 & AN668 TERMINALS . . . THEIR USE ALSO SAVES VITAL MATERIALS AND CUTS DOWN THE LABOR COSTS OF CONTROL ASSEMBLIES

If you have not received a copy of the new bulletin that gives you all the facts about these new **TRU-LOC** *Terminals, write our Detroit office.*

ACCO

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AMERICAN CHAIN & CABLE COMPANY, INC. • BRIDGEPORT, CONNECTICUT

AUTOMOTIVE AND AIRCRAFT DIVISION

6-235 GENERAL MOTORS BUILDING DETROIT 2, MICHIGAN

The flooring is made in seven different weights to allow for a wide range of applications including catwalks, benches and table tops as well as passenger-compartment flooring. It is not recommended at present by the maker for use in compartments designed strictly for cargo, since the phenolic surface is subject to cracking when struck a sudden blow with a heavy weight such as might easily be suffered during loading operations. For occasional cargo use, however, Panelyte flooring has proved satisfactory when covered with a thin plywood veneer.

The thickness of the aluminum insert, which is included to equalize the tension values on the bottom with the compression values of the top surface varies directly with the weight of the laminated sheet. Lightweight sheets for table tops are made without insert, and the heavier sheets have inserts ranging from 0.010 to 0.040 in. in thickness. Tests have revealed that an insert thickness of 0.020 in. or more is most satisfactory for flooring.

The Glenn L. Martin Company is now using Panelyte flooring in the after deck of the Martin Mars and plans to use this new material extensively in new flying boats being built for the U.S. Navy and in the large postwar passenger planes. The Martin company has licensed St. Regis Paper to manufacture this metal re-enforced plastic flooring and make it available to other aircraft manufacturers. The Glenn L. Martin Company.

Heat Exchanger

The Niagara Aero Heat Exchanger was developed for adding heat to industrial liquids for the purpose of maintaining constant temperatures as desired, with automatic control. The method has not been previously available with the evaporative type liquid-cooling unit, using a water spray and fans to draw air over coils containing the liquid whose temperature is to be controlled. This is accomplished by using either a steam coil or injector or an electric heating unit to heat the spray water. A United States patent has recently been granted on this equipment.

The result is control of liquid temperatures within prescribed limits, alternately cooling or heating as required. The heating device is put into operation by thermostatic control at the desired point, preventing the liquid from becoming too cold for the process in which it is used; from becoming viscous, with retarded flow and loss of capacity; or from congealing or freezing. This also makes it possible for the heat exchanger to be installed out of doors or to use fresh, out-of-door air to increase its evaporative cooling capacity and avoid damage from handling air containing corrosive substances.

The heat exchanger with these features is used to control temperatures in industrial chemical processes and electrical equipment by controlling jacket water temperatures, also quenching baths in the heat-treating of metals; cutting oils and lubricants in metal-working; machining and wire drawing; controlling temperatures of chemical-process liquids in many fields; and engine jacket water. It is also applied to air and gas compressors. Niagara Blower Company, New York, N.Y.

Armament of the Mustang

Some of the P-51 Mustang fighters recently produced are reported to have been equipped with four 20-mm. cannon, making these airplanes capable of exploding locomotives and destroying small merchant ships while retaining their qualities as fighters.

Prior to installing the armament used on this particular version of the Mustang, North American Aviation conducted a series of exhaustive tests of the 20-mm. cannon extending over many months. Text firings of the cannon were made on the ground and in the air and in fast climbs from sea level to 30,000 ft., while motion-picture cameras and other instruments recorded the results for study by armament engineers at the plant. It is stated that the Mustang's cannon tore out gashes 1 ft. long and 3 in. wide in a target-test wing section during firing tests at the Inglewood plant.

Installation of the 20-mm. cannon in the Mustangs demonstrated that a number of big guns could be used sucessfully in a fighter without causing "bumps" in the surface of the wings. North American Aviation, Inc.

X-Ray Unit

The electronic Searchray is offered as a simple, compact x-ray unit that can be operated safely by unskilled personnel for any condition for which x-ray inspection is desired. It is both fluoroscopic and radiographic in action and provides a quick means for the nondestructive internal inspection of small parts; molds; castings of light alloys; ceramics; plastics and rubber; packaged products; assemblies; and semifinished and finished products.

No elaborate and expensive tools are needed for its operation or installation. There is no intricate system of dials or controls to adjust. The operator simply plugs into any standard 110-volt power supply, places an object in the compartment, closes the door, and presses the button. The object can then be instantly seen fluoroscopically through the eye-level eyepiece. Safety for the operator is obtained by a rayproof, shockproof housing with full automatic electric interlocks that interrupt the circuit while the compartment door is open.

Searchray is supplied with accessories that permit radiographic examination covering a maximum area of 11 by 14 in. using standard 12- by 14-in. x-ray film or paper. The compartment is 21 in. long by 18 in. deep by 9 in. high. The fluoroscopic screen measures 12 by 16 in. and the maximum area observable at any one time is $8\frac{1}{2}$ by $11\frac{1}{2}$ in. The instrument is also applicable for plant-protection work by providing a quick, safe method of examining the contents of incoming and outgoing packages and small luggage—thereby saving the time, annoyance, and danger of opening unknown parcels. The unit is portable and occupies less than 5 sq.ft. of floor space. North American Phillips Company, Inc., Dobbs Ferry, N.Y.

15-KW. Induction Heating Machine

The new 15-kw.-output Tocco Junior induction heating machine is a small, compact 9,600-cycle high-frequency unit that is designed for a wide range of induction heating applications. It can be adapted to brazing, annealing, heat-treating, heating for forging, and surface hardening of small and medium-sized parts. The steel construction is welded and is claimed to be capable of providing continuous operations with a minimum of maintenance and care. Trained electrical engineers are not necessary for normal operations.

Inductors for the brazing of carbide tips are designed to treat more than one size of tip before a change in inductors is necessary. Any shift is accomplished by unscrewing two connections on the transformer panel. Machines are available with one or two working stations.

The new model occupies approximately 10 sq.ft. of floor space and stands 51 in. high with the work pan set 35 in. above the floor. Only three connections are needed—two for water and one for power, 220/440 volts.

Features of the larger Tocco machines are incorporated in the 15-kw. unit. It offers preset automatic controls, quenching auxiliaries, transformers, capacitors, meters, and push-button starting and stopping. Timers are placed on the front panel beneath the work pan flanking the meter board which is protected by a grill. Protecting the air-cooled motor compartment from shop grime and dust are filters set behind the ventilating louvres. The Ohio Crankshaft Company, Cleveland, O.

Glass and Plastic Combination for Self-Sealing Tanks

A new synthetic plastic reinforced with glass is being used in the self-sealing gasoline tanks in certain types of warplanes. The glass used as reinforcement is in the form of glass cloth woven from yarns.

As the self-sealing gasoline tank was first developed by plane designers and tested in the laboratory, it was not always self-sealing. When a bullet punctured the metal surrounding the tank it sometimes caused the metal to "flower" with the result that the jagged petals of the flower protruded into the self-sealing material of the tank, making it impossible for it to close the hole.

To remedy this, a plastic reinforced with glass cloth and pressed into thin sheets was placed between the metal and the tank. The plastic and glass combination is said to be strong, light in weight and, unlike metal, it does not flower. The result is that a bullet

To meet EXTREMES

"Stromberg" Carburetion

COMPENSATES INSTANTLY AND AUTOMATICALLY

Whether it's a swift rise upstairs from blistering-equatorial heat to sub-zero cold, a power dive on an enemy carrier, or the sudden bank of a fighter plane in a dog-fight,—"Stromberg" Injection Carburetion dependably meters fuel with mathematical accuracy in proportion to air. Combining automatic metering with positive pressure-atomizing of the fuel spray, the "Stromberg" Aircraft Carburetor compensates instantly for all changes in conditions of flight. In pace with each amazing development of engine and plane designers, Stromberg engineers study the lessons of both laboratories and battle fronts to keep "Stromberg" Carburetors *as great as the ships in which they fly.*

"Stromberg"
INJECTION
CARBURETOR

The "STROMBERG" Aircraft Carburetor is an important member of "The Invisible Crew" . . . precision instruments, and controls, which Bendix plants from coast to coast are speeding to our fighting crews on world battle fronts.

THE INVISIBLE CREW
Precision Equipment by
Bendix
AVIATION CORPORATION

BENDIX PRODUCTS DIVISION
of Bendix Aviation Corporation
South Bend, Indiana

striking the tank makes a clean hole, with nothing to prevent self-sealing materials from closing it. Owens-Corning Fiberglas Corporation.

Dehydrator for Prevention of Corrosion

A technique for packaging guns, engines, airplanes, and machinery to prevent rusting and corrosion damage during the time that these metal war implements lie in freighter holds and dockyards has been facilated by the development of a chemical that not only can draw half its weight in moisture out of damp air but also gives a signal to indicate when the humidity inside a war package rises above the point where rust occurs. The chemical is known as granular silica gel.

With silica gel the process of degreasing is eliminated and equipment arrives ready for use. The chemical is claimed to protect metal parts by keeping the humidity of the entire package below 20 per cent. Silica gel granules absorb half their weight of water by physical action and do not swell, dissolve, or have any chemical reaction during the absorbing process.

By examining a humidity indicator in each package—a card containing cobalt-impregnated silica gel that changes color as the air within the package changes in humidity—inspectors can tell when the silica gel has absorbed its capacity of the moisture in the package or if the moistureproof wrapper is leaking. When the air is dry the cobalt granules are a deep blue, but, as humidity in the package increases, the granules change to violet, through pink to white.

In corrosion-proofing an aircraft engine, bags of silica gel are tied to each cylinder and placed in other strategic spots and the humidity indicator card is attached to one end of the engine. A moisture-proof bag is drawn over the engine before crating, and a transparent plastic window in the shipping box permits inspectors to check the indicator card without disturbing the wrap. Guns and other ordnance items are similarly sealed and crated. Permutit Company.

Metal Plating of Plastics

A new process is announced by which plastics, glass, or any nonconductor can be plated with any of the plating metals. Plating of plastics in the broad range to which this improvement is applicable is now in progress.

By the new process it is claimed that the plating goes on the plastics as perfectly and as permanently as any plated metal. Convex and concave surfaces, convolutions, corners, and recesses are as thoroughly plated as flat or simple round surfaces. The metal plating is permanent. It does not crack, chip, or peel off in long and severe service.

The new process can be used for plating magnetic and electric shielding of all kinds—radio shielding, electrostatic and magnetic shielding, applicatons as coil

Tinnerman Products' latching wire harness clamps.

shields, condensers, etc. Plastic articles can be had to match any of those made of metals. Conductor and insulator can be combined in one unit. Both rigid and pliable types of plastic tubing and pipe fittings can be plated. The uses of the process extend into many branches of electrical and mechanical manufacture. Precision Paper Tube Company, Special Products Division, Chicago, Ill.

Coupling Nuts from Sheet Aluminum

Faster production of AN conduit, coupling, and lock nuts is reported to be the result of a new manufacturing development that fabricates these nuts from sheet aluminum.

Tests under actual working conditions are quoted to show conduit nuts to be as strong as machined nuts, and they are claimed to be stronger and more consistent in strength than nuts which have been die-cast. It is also stated that the new method develops a much lighter nut.

The makers say that materials may be conserved because not only is there less waste in this process than in machining but more aluminum sheet stock is available than aluminum bar stock. Machine time, too, can be saved through speeded production and simpler machine processes.

The AN 3054 series of coupling nuts is now being produced in sizes -3, -4, -6, -8, -10, -12, and -16. The Rumson Company, Los Angeles, Calif.

Thread Roll Snap Gauge

The Sheffield Thread Roll Snap-Gauge, a combined "Go" and "No Go" limit gauge for rapidly checking male threads to both maximum and minimum limits in one operation, consists of a frame similar to a plain snap gauge in which two sets of gauging rolls are mounted, each roll being free to rotate. One set of rolls represents the "Go" limit, and the other the "No Go" limit.

Thread roll snap gauges not only check the assembly of male threads with female threads but also assure uniform interchangeability within prescribed limits of the work passed. In addition, they reveal specific inaccuracies so that steps can be taken to correct the tool or machine at fault.

By exposing any errors through checking critical conditions in the thread itself such as pitch diameter, thread angle, and lead, it is reported that thread roll snap gauges go beyond the conventional gauging practice.

Among the advantages claimed for the gauge are faster inspection and economy through long life because of little wear and the reduction of the number of gauges required. These gauges are furnished standard for American National form, coarse and fine series. Gauges for all other forms are considered special and made to order. The Sheffield Corporation, Dayton, O.

Redesigned Rivet Sorter

It is claimed that the No. 101-Mode B rivet sorter unit can be efficiently operated at an approximate cost of 15 cents per pound of rivets salvaged, including investment, operation, and depreciation, and that it can sort 50 to 60 lbs. per hour.

This new unit was based upon and redesigned from an original design by William Chilton and manufactured by Fisher Body. Several improvements over the original Chilton design are said to have been made. The original was limited in its shank diameter selection to increments of $^1/_{16}$ in. This unit selects in increments of $^1/_{32}$ in. in length. Another improvement is the addition of a separate section for sorting rivets by head sizes. Other refinements increase the number of sizes that can be sorted.

The No. 101-Model B unit consists of two sections, the screening section and the disc sorter section. It handles countersunk, brazier, and flat and round head rivets. Southern Engineering Company, Inc., Los Angeles, Calif.

Oil Reconditioner

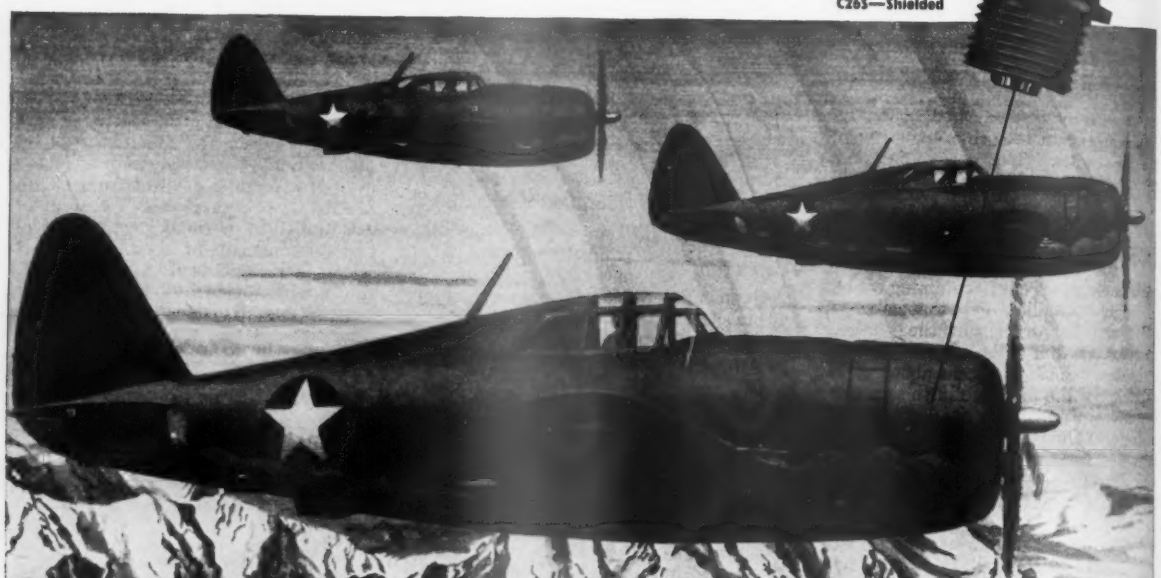
A complete oil-treating, filtering, and reconditioning machine is especially designed for reconditioning cutting, grinding, and honing oils that should be heated before filtering. Many of these oils must be filtered very sharply in order to remove the microscopic metal particles, germs, and other impurities. If this is done at room temperature, however, some of the additives of these oils, such as sulphur, lard, wax, etc., are removed, impairing their quality. If the oils are heated to a temperature of 170° to 200°F., these additives are in solution and will not filter out. Heating tends to sterilize the oil and thus prevent dermatitis.

The equipment consists of a 100-gal. mixing and heating tank that is equipped with electric immersion heaters, a mechanical agitator, a thermometer, a filter aid storage box of 50-lb. capacity, a main line fused knife switch, a magnetic push-button controller, a Sparkler Model 18-D-2 horizontal plate 600-gal. per hour filter, a rotary pressure pump, and a 1-hp. motor. The pump is so arranged that it can be used as a transfer pump to pump the oil from the pump into the heating and mixing tank and also to pump the oil through the filter. The tank will heat 100 gal. of oil from 80° to 180°F. in 30 min.

CHAMPION SPARK PLUGS

in today's high output, turbo supercharged engines take a lot of punishment. The same qualities that made Champion the spark plug of racing champions have skyrocketed them to favor for our most powerful aircraft engines.

C26S—Shielded



C26—Unshielded

Just as no chain is stronger than its weakest link, so no spark plug is better than its insulator.

The insulating material used in Champion Ceramic Aircraft Spark Plugs is a revolutionary, new development, having properties and advantages unequalled by any other insulating material.

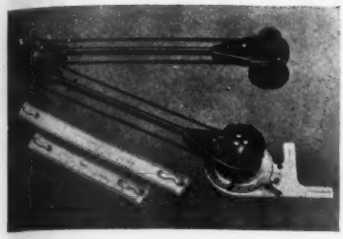
Its resistance to heat and mechanical shock—wide variation in temperature and pressures—make it ideally adapted to the manifold ignition problems encountered in high altitude flight.

In addition, Champion Ceramic Aircraft Spark Plugs are backed by thirty-odd years of experience in the spark plug field exclusively—a certain "know how" that is evidenced by their outstanding dependability with our air forces.

Characteristic advantages of Champion Ceramic insulation are:

1. Immunity from heat and chemical reactions.
2. Freedom from fuel, oil, or moisture absorption which causes "shorts".
3. Inherently high heat conductivity with consequent wider range between pre-ignition and fouling.
4. Absolute uniformity of material.
5. Homogeneous structure eliminates air spaces which cause current leakage.
6. Easily cleaned and serviced—no specialized equipment or factory returns necessary.
7. Scientifically controlled manufacture.

USE CHAMPIONS AND FLY WITH CONFIDENCE



The Vemco Junior portable drafting machine.

It is claimed by the manufacturers that sulphinated oils, lard oils, lubricating oils, and many other oils can be restored to their original efficiency and sterilized with this equipment. The machine is portable and compact. It is mounted on ball-bearing casters, and two lengths of Neoprene hose are supplied. Sparkler Manufacturing Company, Mundelein, Ill.

Aircraft Lubrication Chart

The Aviation Sales Division of the Esso Marketers has announced the distribution of what are believed to be the first lubrication manuals for aircraft.

Automotive dealers for many years have had lubrication charts to guide them in the use of the correct grades of lubricants, methods of application, and recommended frequency of service. These features have been included in the aircraft lubrication chart to help dealers in aircraft fuels and lubricants to provide the highest type of lubrication work.

The chart is so assembled that revised or new pages may be added as new lubricants become available or new equipment is developed. While in use it may be conveniently hung on the nearest wall or on the aircraft itself for ready reference.

Sections include general information and instructions in aircraft lubricants and fuels, descriptions and Government specifications for different grades, and specific recommendations covering the grades and types of fuel and lubricants for current models of aircraft engines. The charts contain sketches of various airplane types, with symbols indicating the location and kind of lubricant required. Standard Oil Company of New Jersey.

Latching Wire Harness Clamps

Wiring harness clamps with a latching finger have been released for use in aircraft and other equipment. These clamps work independently of the attacking screw in the assembly of wire harnesses. Any or all of the wires may now be removed or replaced without even loosening the screw that holds the clamps in position. These clamps are used in place of "boggles" at the point of make-up. They remain snapped over the wires during transportation to final assembly location and then serve as the mounting means for attaching harness to structure. Made of spring steel that has been Parkerized and given two coats of lacquer, they are cushioned with extruded synthetic rubber channels having integral resilient ribs to absorb variations in thickness of harnesses. Two different latching stations are provided on each clamp for size adjustment to fit varying numbers of wires. Tinnerman Products, Inc., Cleveland, O.

Paint Recovery Aided

A new and important use in the paint-recovery program was discovered recently for a chemical compound called Turco Deflocculator, according to the manufacturers. By preventing the formation of scum on the top of tanks, it is claimed that this agent aids in producing a higher quality of sludge which stays smoother and is dispersed easier after reclaiming. Designed as a chemical treatment for circulating water systems in paint spray booths, Turco Deflocculator's original purpose was to prevent breaks in the water curtain by emulsifying oil and resinous vehicles and dispersing pigments so that they could not deposit on the metal walls of the spray booth. Turco Products, Inc., Los Angeles, Calif.

Rubber-to-Metal Bond

The Reanite Bonding Process for bonding plastics or natural or synthetic rubber to metals is claimed to develop a bond between rubber and metal ranging from 900 lbs. per sq.in. to as high as 200 lbs. per sq. in. on a pull test. This is said to compare with bonds ranging from 250 to 400 lbs obtained by present methods. While the bond develops its maximum strength at room temperatures, its strength over a range of −40° F. to as high as 300°F. is indicated as being substantially stronger than bonds obtained by conventional processes.

The process is suitable for bonding natural or synthetic rubber or plastics to almost all metals—iron, steel, stainless steel, magnesium, aluminum, aluminum alloys, copper, bronze, or brass. It also may be used to bond metal to metal, or leather or wood to metal, or to each other. The surfaces to be joined are brushed, sprayed, or dipped with Reanite. After being permitted to dry for an hour, the surfaces are joined and the unit is vulcanized by any of the conventional methods. The United States Stoneware Company, Akron, O.

Portable Drafting Machine

A small drafting machine that can be mounted on a portable board and used in shop or field is called the Vemco Junior Drafter. Through the use of shock-resisting plastics it combines light weight (3 lbs.) with many of the advantages found in large, high-priced drafters, according to the manufacture.

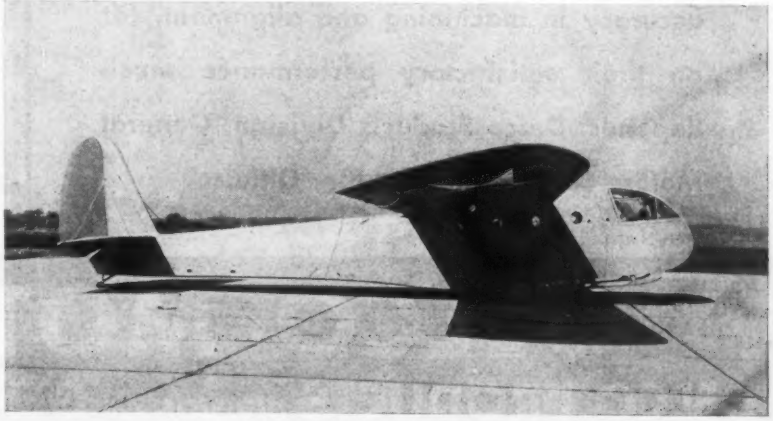
Accurate, parallel motion over the entire board; a full circle baseline setting; prelubricated and double-sealed ball bearings; and enclosed pulleys are a few of the features claimed by the Junior Drafter. Disc brakes at anchor and elbow allow the drafter to be used on steeply inclined boards. The central skid button is made of plastic in order not to mar the paper.

Lightweight aluminum scales are available in 8- and 12-in. lengths and fit into resilient, slotted ducks in the positive scale holder. The protractor is $3^3/_4$ in. in diameter and graduated in degrees with figures by quadrants.

The scales lie flat, and the head can readily be raised high off the board. The standard Vemco patented band-tightening device is used on the Junior model. A 10-min. vernier plate can be supplied at slight additional cost. V. & E. Manufacturing Company, Pasadena, Calif.

Waco CG-4A Glider

The Waco CG-4A troop- and cargo-carrying glider is an externally braced high-wing monoplane of wood and steel tube and fabric-covered construction. It has a wing spread of 83 ft., 8 in. and an overall length of 48 ft., $3^3/_4$ in. It carries 15 fully armed and equipped men, two of whom act as pilot and copilot.



The Waco CG-4A troup glider.

PRECISION ASSIGNMENT

TRANSFER PUMP MOTOR

BOOSTER PUMP MOTORS

TURRET MOTOR

WINDSHIELD WIPER MOTOR

INSTRUMENT PUMP MOTOR

SERVO MOTOR

Compact in design—light in weight—Delco aircraft electric motors conform to latest military specifications for Army and Navy planes. They are built to close limits of accuracy in machining and alignment, for on their satisfactory performance much depends. Delco Products Division, General Motors Corporation, Dayton, Ohio.

DELCO MOTORS

DELCO PRODUCTS *DIVISION OF* **GENERAL MOTORS**

As an alternate loading condition this model of the Waco glider is designed to carry a standard U.S. Army Ford or Willys 1/4-ton truck with four men as crew plus two men as extra crew and equipment to make up the full disposable load. Another alternate load to the 1/4-ton truck is one standard U.S. Army M3A1, 75-mm. howitzer and carriage, with gun crew of three plus glider crew of two, and ammunition and supplies to make the full available disposable load.

The Waco CG-4A weighs more than 7,000 lbs. gross when fully loaded and flies at an altitude as great as 20,000 ft. The builder states that it can be towed by an airplane at a speed of 120 m.p.h. or glide at 38 m.p.h. without stalling. It is equipped with blind-flying instruments and oxygen equipment, and most of the instruments are control devices found on the modern high-speed airplane.

The ratio of a CG-4A glider's forward progress caused by loss of altitude ranges from 6 to 1 to 30 to 1, depending on wind direction, weight, and other variables. The statement is made by the builders that even at the minimum ratio a glider towed to an altitude of 25,000 ft. could fly more than 25 miles into enemy territory without its presence being revealed by enemy sound detectors. Waco Aircraft Company, Troy, O.

Motors for Stratosphere Wind Tunnel

Construction of two 20,000-hp. electric motors for the Army's new stratosphere wind tunnel at Wright Field has been started. Each twice as powerful as the biggest electric motors supplied to steel mills, the two driving units will generate a more-than-600-m.p.h. torrent of cold air to test high-altitude performance of combat planes.

The new tunnel will be a rectangle of metal pipes 600 ft. long and varying in diameter from 10 to 40 ft. It will adjoin the 400-m.p.h. tunnel, which is powered by a single 40,000-hp. Westinghouse motor, reported to be the largest of its kind in the world. The test chamber of the new tunnel will duplicate the conditions in the lower stratosphere, 7 or 8 miles above earth.

More than 4,000,000 cu.ft. of air per minute will be pushed through the tunnel by two counterrotating propellers mounted hub to hub in the 19-ft. section of the tunnel. The two propellers will produce a smooth, nonturbulent flow of air, which gives a representation of stratospheric atmosphere. The two motors will be mounted at adjacent corners of the tunnel and each will be connected to its propeller by a 40-ft. shaft piercing the tunnel wall. The top speed of each motor will be 465 r.p.m. The motors can be slowed down to 50 r.p.m., reducing the blast in the tunnel to a moderately stiff wind A blower under each motor will send 50,000 cu.ft. of air per minute over the cores and windings to carry away the motor's heat. Each motor will be about 11 ft. high and 25 ft. long, including shaft and bearings. The rotor of each motor will weigh 33 tons.

Westinghouse is also building the propeller hubs and the shafts connecting each hub to its motor. These shafts will ride on bearings inside the tunnel. Westinghouse Electric & Manufacturing Company.

(*Continued from page 39*)

"stall" of the airplane. It is not unlikely that more emphasis should be put on developing skill in recognizing an approaching stall and effecting a recovery after inadvertently falling into one.

Instruction Recordings

Accepting the courses as now designed, the Committee began its investigation of flight instruction by recording the actual instruction given a student by his pilot teacher and the students' questions and replies during flight.

These recordings were made on the ground by means of short-wave radio sent from the plane. Psychologists and experienced pilot instructors analyzed the records thus obtained. They showed wide variations in instructors' methods. In some cases they revealed that definite misinformation had been given the student. To correct these conditions, a "patter book" for the instructor and a condensed manual for the student were prepared and put into use by the C.A.A. At the request of the Navy, the Committee assigned one of its research men to assist in preparing editions of these two booklets for research men to assist in preparing editions of these two booklets for elementary Naval flight training. The use of these devices is now standard practice in the C.A.A. and Navy flight training schools.

A new speech-recording device has recently been developed which promises to speed up research on instruction methods. It does not require radio equipment and can be installed in the conventional light plane. When an instructor is sent up with a student, the lesson in all its details can be recorded with high fidelity. The record can be "played back" on the ground in the presence of the instructor, the supervisor, and, if necessary, the student.

The vocabulary, content emphasis, quality of speech, and the like can be discussed. This method gives high promise of improvement in teaching methods.

Now, for the first time, devices are available which permit the use of a vast amount of teaching knowledge developed by educational psychologists in our regular schools. Without these instruments this great fund of knowledge could not have been used in flight instruction because the flight instructor would remain isolated in the air, with his student unaware of his own skills and deficiencies.

Objective Methods

It seems likely that the development of objective devices for measuring the skills and methods of flight instructors, and the development of objective methods for training such instructors, will create a new professional position in aviation—that of pilot instructor.

The C.A.A. Division of Research has also established a precedent with its experiment to determine the minimum number of hours of flight instruction required on a particular type of airplane before application can be made for a private pilot certificate. The airplane used was one of unconventional design and licensed by the C.A.A. as spinproof. It was of the two-control type, lacking rudder pedals and pilot control of rudder. Approximately 40 students were taught to fly the plane during the experiment, and as a result the C.A.B. set the requirements for this plane as follows: minimum time of dual instruction before solo, 5 hours; minimum total hours before flight test for private certificate, 25 hours. The flight time requirements now prevailing for pilot certification are based upon the judgment of experienced officials. It is the writer's belief that as a result of this experiment manufacturers are now likely to demand more objective criteria for determining minimum requirements. Certainly, helicopter manufacturers and makers of unconventional light planes are going to be interested in the subject if convinced that less exacting requirements should be demanded of pilots operating their ships than those of more conventional design.

The C.A.A. research program has revealed the possibility and desirability of applying to the human machine in aviation the same objective research methods now employed in testing and improving the airplane itself.

San Francisco to Salamaua

ROHR equipped Consolidated Coronados flown by Pan American to outposts of attack

Teamwork . . . a vital weapon of the United Nations . . . begins in war production factories and extends to fighting units on every front.

Teams of Rohr Production Fighters work around the clock preparing huge Consolidated Coronados for the next team . . . skilled flight crews of Pan American World Airways . . . on a mission of quick supply to far-flung forces of the Allies.

Teamwork is the dominant spirit of men and women on Rohr production lines . . . determined to help cut the time to Victory!

HELPING TO WRITE THE STORY OF TOMORROW

ROHR

PARTS ☆ ASSEMBLIES

ROHR AIRCRAFT CORPORATION • CHULA VISTA, CALIFORNIA

Institute News

Record Parachute Jump

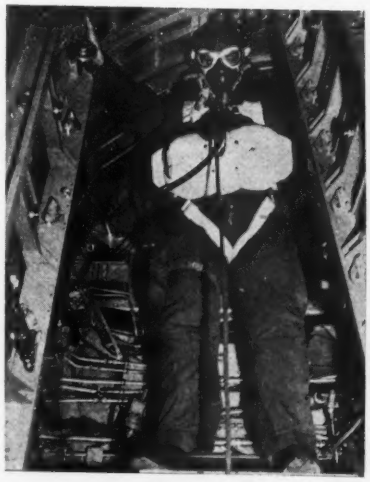
Lt. Col. W. R. Lovelace, a member of the Institute, established what is believed to be at least an American record for a parachute jump of 40,200 ft. on June 24. Colonel Lovelace, who is Acting Chief of the U.S. Army Air Forces' Aeronautical Medical Laboratories at Wright Field, undertook this record jump to determine for himself the effect of extremely high altitudes on the human body and to measure the effectiveness of existing emergency parachute equipment. The record is considered to be an outstanding one because it was not a "delayed-opening" jump, as most other high-altitude jumps have been. Instead, his parachute was opened by a static cord immediately after he left the plane, so that he parachuted the entire distance to the ground.

The record parachute descent was made from Boeing Field, Seattle, in a Flying Fortress used as a "laboratory" plane by the Boeing Flight Test department. A smaller plane accompanied the Fortress but remained at a lower altitude to observe the descent of Colonel Lovelace and follow him to the ground.

Colonel Lovelace wore regulation underclothes, trousers, and blouse. He wore an outer suit of gabardine and under it a processed "chicken feather" suit for extra warmth. He had on helmet and goggles and two pairs of gloves (one of silk, next to the hands, and another of leather).

Emergency oxygen was in two bottles, each good for about 20-min. supply. One bottle was connected by tube to a standard oral-nasal mask; the other bottle fed into a tube only, to be placed directly in the mouth if the mask should fail to function or if the oxygen in the mask bottle should be exhausted for any reason. Colonel Lovelace wore two parachutes, a standard Army and Navy 28-ft. back-pack chute and a chest-pack 24-ft. chute for emergency. A "static line" from the rip cord of the back-pack parachute fastened at the other end to a clamp in the bomb bay.

At the predetermined altitude for the jump of 40,200 ft., the temperature was −40°F., and the indicated airspeed of the slowed-down plane was 100 m.p.h.



Lt. Col. W. R. Lovelace standing in the bomb bay of a Flying Fortress demonstrating the manner in which he planned his jump.

Gifts to the Aeronautical Archives

During the month, the model collection on exhibit was increased by a set of 18 examples, covering the history of aeronautics from Leonardo da Vinci's ornithopter of 1490 to a rocket plane of 1930. This set of models was loaned for an indefinite period by Lt. Col. C. R. Borkland. A set of 67 models used in training was sent by the Bureau of Aeronautics of the Navy Department.

Dr. Alexander Klemin, of New York University, gave a number of pamphlets, books, and issues of periodicals, including publications of foreign companies which were not previously in the collections of the Aeronautical Archives. The principal subjects covered are airports and air transportation.

Through the kindness of H. S. Resing, the Archives received a complete file of the official publication of the National Association of American Balloon Corps Veterans, *Haul Down and Ease Off*. A complete file of the *Aero Research Technical Notes* of Aero Research Ltd., Duxford, Cambridge, and a gift subscription to current issues was received.

The British Air Commission sent additional *R.T.P. Translations* to add to the large collection previously given and a pamphlet by W. J. Duncan, *Free and Forced Oscillations of Continuous Beams*.

Copies of its *Drafting Room Manual* and *Loft Handbook* were received from the Lockheed Aircraft Corporation through the courtesy of Hall L. Hibbard.

Miss Pearl C. Gregory, of Morristown, N.J., gave several photographs of the Asbury Park Meet in 1911. The Western Electric Company gave a calendar with a picture of a transport plane over the Kitty Hawk monument, issued in 1939. The Republic Aviation Corporation gave a framed flight picture of the P-47.

An insignia calendar was received from Pesco Aircraft Products through the courtesy of Robert Minshall, and this company also sent a complete set of its bulletins and catalogues. A. Leo Stevens added a number of photographs and clippings to the large gifts previously sent. Mrs. Bella C. Landauer added a number of items to the great collections she has given to the Archives, including a photograph of the Los Angeles Aviation Meet of January, 1910. Miss Dorothy Monro gave several issues of magazines and a number of clippings, principally from Boston newspapers of 1942 and 1943.

Charles Adler, Jr., of Baltimore, gave the original documents assigning his patents on aircraft taillights to the people of the United States of America, together with signed copies of the patents.

The Division of Aeronautics of the Library of Congress sent 51 books from its duplicate exchange collection, many of which were not previously in the Aeronautical Archives. The collection consists mainly of French and German titles of the nineteenth and early twentieth centuries.

A. Roy Knabenshue made it possible for the Archives to add his personal collection of books, photographs and papers to its growing resources on the history of American aeronautics. The first shipment consisting of books and patent specifications was received during the month.

Alden Hatch gave several contemporary photographs of Glenn H. Curtiss. Richard C. Langner gave some interesting bookplates and a deck of spotter cards from his large collection of aeronautica.

Aeronautical Engineering Catalog

Recognizing the aeronautical engineer's need for a single, centralized source of reference on aircraft materials, parts, and accessories, the Institute is now preparing an AERONAUTICAL ENGINEERING CATALOG as a further service to the industry.

Publication is scheduled for the early part of 1944, at which time some 7,000 copies will be distributed to all key men and manufacturing companies; Army, Navy and Government personnel; and educational institutions and engineering libraries concerned with the design and manufacture of American aircraft.

The primary purpose of the CATALOG will be to provide aeronautical engineers, designers, and production men

ARGUS—With a Hundred Eyes That Never Sleep

British fighting men know it as the *Argus*—named for a character out of Greek mythology who had "a hundred eyes that never sleep."

To Americans it is the *Forwarder*—the dependable, sturdy little utility-cargo plane.

Officially designated by the U. S. Army as the UC-61A, this little-sung member of the Fairchild airplane family is doing a heroic around-the-clock job on many a fighting front of the United Nations.

Getting precious medical supplies through to where they are needed in a hurry.

Carrying the ammunition to where it is needed most.

Setting down and taking off in tiny patches of clearing, so small that larger planes could not use them.

Shuttling Army personnel between staff headquarters and "where the shooting is."

Acting as the eyes of the Army in remote or inaccessible observation posts.

These and a hundred and one other routine duties well performed have long since earned for the trim little UC-61A the undying affection of men who have depended upon it to get them in and out of tight places.

Those who envision the universal use of airplanes after the war—both commercially and privately—may see in the four-place UC-61A the forerunner of tomorrow's taxi of the air. Another example of Fairchild's "touch of tomorrow in the planes of today."

BUY U. S. WAR BONDS AND STAMPS

Fairchild Aircraft

Division of Fairchild Engine & Airplane Corporation, Hagerstown, Maryland.....Burlington, North Carolina

with specifications, illustrations, and information on such materials and parts used in aircraft and aircraft-engine design and production. All products and manufacturing companies listed will be cross-indexed to make this CATALOG a handy and valuable reference volume.

Copies of the CATALOG will also be supplied on request to Institute members. Special request cards will be mailed to all members in the near future, and those desiring copies may reserve them at that time.

Welman A. Shrader, of the Institute staff, is Editor of the CATALOG, and Russell F. Rogers is Manager.

Registry of Aeronautical Engineers for Postwar Planning

For the past 6 weeks the Institute has been compiling an Aeronautical Engineering Registry as an initial step toward postwar planning. It was felt that such a registry, containing biographies and certified records of all qualified engineers and aeronautical specialists, would prove of value to the individual as well as to the industry during the adjustment and relocation period following the war.

Special Registry Forms have been prepared for this purpose and are now being supplied in bulk to manufacturing companies for distribution to their individual aeronautical engineers.

The early returns from this program indicate the complete cooperation of the companies and individual engineers in attaining the Institute's objective. It is hoped that this registry will augment the Institute's confidential file, already containing biographic material of more that 17,000 aeronautical specialists, to include all engineers in the profession. Through this registry, the Institute can render its members and the industry a real service.

New Directory

The Appreciation Pages to Corporate Members of the Institute, which have been published in the JOURNAL OF THE AERONAUTICAL SCIENCES, and the Directory of Aircraft Products and Services, which has been published in the AERONAUTICAL ENGINEERING REVIEW, have grown so large that the Institute of the Aeronautical Sciences believes it can best serve the aircraft industry by having them issued separately.

The new directory will be distributed as an added service to Corporate Members and advertisers beginning in October and quarterly thereafter. Issuing this directory quarterly instead of monthly will also contribute toward the conservation of paper.

The directory will be even more complete in its new form. It will have a complete products listing in each issue, together with the firm name and address of all Corporate Members and participating companies.

Copies will be mailed to members of the Institute and subscribers, providing wide distribution in the aeronautical manufacturing industry.

New Corporate Members

The following are brief summaries of the products and activities of companies that have recently become Corporate Members of the Institute:

The Doak Aircraft Company, Inc., was incorporated in 1940 and is now engaged fully in war production. The company has manufactured, processed, and delivered metal aircraft components such as complete empennage assemblies, outboard wing panels complete with ailerons and flaps; turret-type gunner's seats; escape-hatch doors; bomb-bay doors; tail-cone assemblies; and other metal aircraft parts.

The company has also formed a working agreement with the Kroehler Manufacturing Company, one of the world's largest manufacturers of furniture, for the national production of wooden aircraft parts and assemblies. This work is carried out by the Kroehler-Doak Aircraft Parts Division.

Embry-Riddle Company operates the Embry-Riddle School of Aviation composed of a Technical School, a Landplane Flight School, and a Seaplane Flight School. At the Technical School, enlisted men of the Army Air Forces, students from the Latin-American countries, and civilians are trained in all phases of aviation mechanics. At Chapman Field, the Landplane Base, Naval Aviation cadets receive instruction for the War Training Service programs. Civilians train for private and commercial pilot licenses at Chapman Field and at the Seaplane Base. The Aircraft and Engine Division (with three bases in Florida) overhauls aircraft, engines, and instruments for the Army, the Navy, and civilian operators.

At Riddle Aeronautical Institute, a division of the Embry-Riddle Company operating Carlstrom and Dorr fields, also in Florida, Army Air Force Cadets are given primary flight training. Embry-Riddle Company, besides developing its manufacturing facilities, is planning a training program in the Latin-American countries. At Riddle-McKay Aero College, Royal Air Force cadets and Army Air Force cadets receive primary and advanced flight training. Riddle-McKay Company of Tennessee is engaged in primary flight training for the Army Air Forces.

The Ridgefield Manufacturing Corporation entered the aeronautical field in February, 1942, when it received a prime contract for CG-4A gliders from the Army Air Forces. The company manufactures the entire glider with the exception of the floor, cap strips, and a few other minor items.

In addition to glider work, Ridgefield has been manufacturing training replicas for the Navy Department at another plant. These may be described as "glorified" mock-ups of actual size but are not, as a rule, reproductions of the entire airplane. Both fighters and bombers have been manufactured. It is felt by the management that the company's peacetime experience, combined with its work on the cargo gliders, has peculiarly fitted it for turning out fine work in this field.

Sections and Branches

Los Angeles Section

The Los Angeles Section held a dinner meeting on August 3, with an attendance of about 100 members and guests. Reginald B. Bland and Paul E. Sandorff, of the Lockheed Structural Research Staff, presented a paper on "The Control of Life Expectancy in Aircraft Structures" (published in the AERONAUTICAL ENGINEERING REVIEW, Vol. 2, No. 8, p. 7, August, 1943). An active discussion followed the reading of the paper.

Illinois Institute of Technology

The Illinois Institute of Technology Branch started the new semester with the induction of officers. The new officers are: Edwin W. Johnston, Chairman; John F. Sluis, Vice-Chairman; and Norman W. Carey, Secretary-Treasurer.

Russel Mueller spoke on the shear center of an airfoil, at the close of which Dr. Reissner added a few brief comments.

Indiana Technical College

Because of the pressure of work and other conditions, meetings of the Indiana Technical College Branch in recent months have been confined to brief business meetings, without formal programs. On August 9, activities were resumed with the summer-term banquet.

New York University

On July 21 new officers of the New York University Student Branch were elected as follows: President, Kenneth Amer; Vice-President, Thomas Scambos; Secretary-Treasurer, Paul Kleinman.

Following the election the film on the Bell Airacobra was exhibited.

CORSAIR FIGHTERS
Brothers in Arms
BUCCANEER AND BERMUDA DIVE BOMBERS
SINCE 1919
Brewster

North Carolina State College

The first summer meeting was held on June 29 and the second meeting took place on July 20. New members were initiated on August 3, at which time seven associate members were admitted. A short business meeting followed the initiation.

At a meeting on August 12 the faculty advisor, Prof. R. F. Rautenstrauch, exhibited the film titled *Building the PBY Record Breakers.*

Spartan School of Aeronautics

The regular July meeting was held on July 16 at which a lecture was given on the Sikorsky helicopter by one of the student members. Following this lecture, the film titled *Forming, Maintenance, and Repair of Plexiglas* was shown.

University of Alabama

At the final meeting of the summer quarter on August 11, the new faculty sponsor, Prof. C. H. Bryan, gave a short talk, and two films were shown, one on the Consolidated PBY and one on the Fairchild PT-19.

Richard Henke spoke on the development of aircraft engines, a paper that is being submitted in the competition for the Institute Student Awards.

News of I.A.S. Members

Malcolm J. Abzug, formerly an Assistant Engineer at Wright Field, has enlisted in the U.S. Navy as a Seaman.

John D. Alexander has joined Boeing Aircraft Company after a term as Aeronautical Engineer with the Consolidated Vultee Aircraft Corporation.

Lilburn S. Barksdale was appointed Chief Project Engineer at Adel Precision Products Corporation, having formerly been Design Engineer with that company.

Capt. Ralph S. Barnaby of the U.S. Navy is now Chief Engineer at the Naval Aircraft Factory in Philadelphia.

Clarence B. Brown, Jr., formerly with The Glenn L. Martin Company, has been called to active duty in the U.S. Naval Reserve and is stationed at the Pratt & Whitney Division of United Aircraft Corporation.

Albert F. Broz has joined Hydraulics, Inc., as Chief Engineer. He was formerly Design Engineer with Bendix Aviation, Ltd.

Lt. Comdr. Oliver H. Cote, Jr., of the U.S. Naval Reserve has advanced to the position of Head of the Structural Modifications Section in the Engineering Division of the Navy Bureau of Aeronautics.

Ralph S. Damon resigned as President of Republic Aviation Corporation but will continue to serve as a member of the Board of Directors. His service as consultant will continue to be available to the corporation without fee for the next several months. Mr. Damon came to Republic Aviation from American Airlines on a "loan" basis to direct the development and production of the P-47 Thunderbolt.

Lloyd H. Donnell has taken charge of Structures Development work at Chance Vought Aircraft Division of United Aircraft Corporation.

James Ford enlisted in the U.S. Army Air Forces.

Frank W. Furry, formerly a Layout Draftsman at North American Aviation, Inc., has been promoted to the work of Stress Analyst in the Structures Unit.

John B. Gearhart has joined the El Segundo Division of Douglas Aircraft Company, Inc., as a Designer.

Roswell W. Gilbert was promoted to director of the Rockaway Valley Laboratories of Weston Electrical Instrument Corporation.

Robert Gottlieb has become partner, with the title of Chief of Structures, in The Shego Company.

Arthur Graham has been commissioned Second Lieutenant in the Army Air Forces and assigned to duty as Service Pilot in the Air Transport Command.

John J. Green, on leave of absence as Assistant Research Physicist in Aerodynamics at the National Research Council in Canada, was appointed Chief Technical Officer at the Test and Development Establishment of a Royal Canadian Air Force Station.

Sergei G. Guins, formerly an Instructor at New York University, has joined Acrotorque Company as Engineer.

Eustace Hetzel is now a Flight Test Engineer with Northrop Aircraft, having returned from his former work with Panagra in Peru.

Edward B. Heyl joined Airlines War Training Institute as Assistant to Director of Training.

John M. Hildt, Jr., enlisted in the U.S. Navy as an Aerographer.

William R. Hopkins is now Engineer-in-Charge of the Gasoline Injection Laboratories, American Bosch Corporation.

Irving A. Johnson has advanced to the rank of Associate Aeronautical Engineer at the Aircraft Engine Research Laboratories of the N.A.C.A., having formerly been Assistant Aeronautical Engineer.

Emil Kissel has been transferred to the Africa Orient Division of Pan American Airways System.

Harold E. Lemont is Head of the Aeronautical Engineering Department of Gazda Engineering.

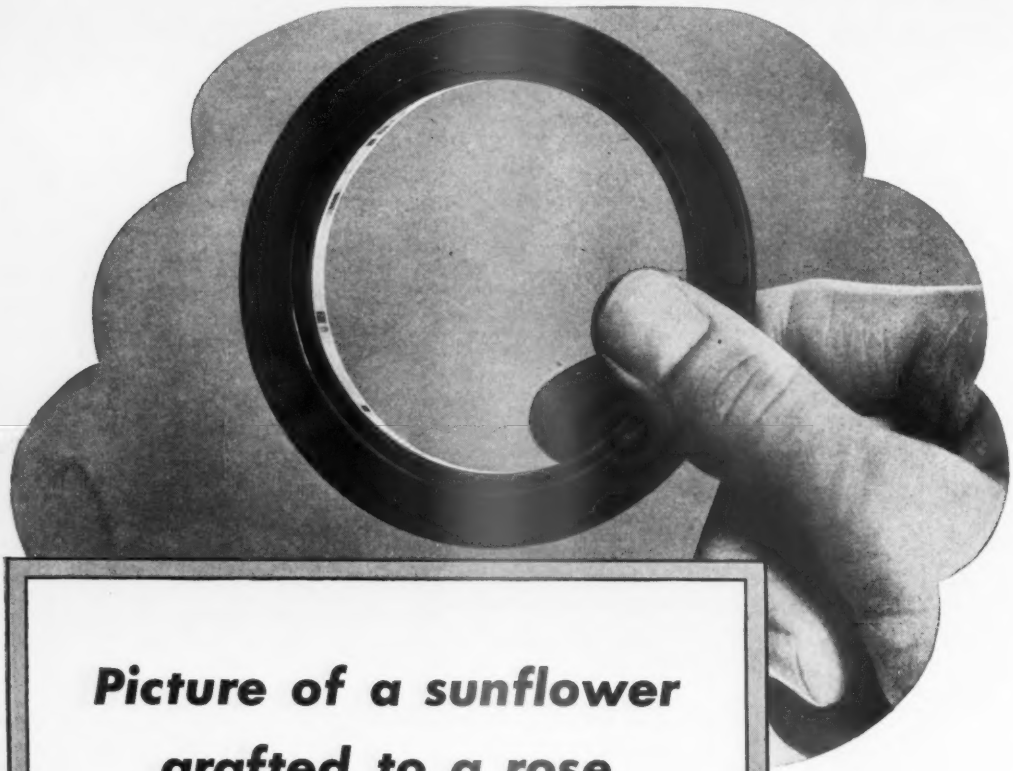
Everard M. Lester is now Assistant General Manager of the Ranger Engines Division of Fairchild Engine and Airplane Corporation. He was formerly Eastern Sales Representative of the Pratt & Whitney Division of United Aircraft Corporation.

Eugene J. Limke has joined Boeing Aircraft Company as a Minor Layout Engineer.

Grover Loening, Consultant on Aircraft of the War Production Board, has been appointed Chairman of its Subcommittee on Helicopters, which is organized under the National Advisory Committee for Aeronautics Committee on Aerodynamics.

Alfred Marchev was elected President of Republic Aviation Corporation to succeed Ralph S. Damon. Mr. Marchev has been with Republic Aviation since February, 1942, serving successively as assistant to the President, Vice-President and General Manager, Director, and Executive Vice-President.

William B. Stout examines a model of his "Roadable Airplane."



Picture of a sunflower grafted to a rose

ILLUSTRATED here is a metal-insert hydraulic seal for aircraft use. The metal was carefully and precisely machined to extremely close tolerances.

But whatever was gained by accurate machining was promptly thrown away, for they bonded to it a resilient material that swells as much as 10% or 15% in hydraulic oil.

It's like grafting a sunflower to a rose.

For fine, close-tolerance performance in resilient materials, engineers in vital war industries are specifying Hycar synthetic rubbers. Why? Because Hycar can be tailored to the job. Oil-swell can be limited to plus or minus 1%, or even held to zero. In addition, Hycar can withstand temperatures of 250°, abrasion resistance is 50% in excess of natural rubber, and compression-set characteristics are excellent.

Hycar is light—20% to 25% lighter than many other synthetics. And its resistance to oil absorption keeps it light.

Aren't these the qualities you have wanted in oil and fuel hose, hydraulic lines, seals, gaskets, grommets, diaphragms and other resilient products you use? *Hycar Chemical Company, Akron, Ohio.*

Hycar is supplied in crude form to rubber fabricators. Because of its outstanding performance in war uses the demand far exceeds the supply. But now is the time to work out with your supplier of rubber products ways of obtaining Hycar for actual test in your own applications, both present and future. It's to your advantage to gain experience now against the day you will need new and even better rubber products. Our technical staff and laboratory are ready to help.

Hycar

LARGEST INDEPENDENT PRODUCER OF BUTADIENE SYNTHETIC RUBBER IN AMERICA

Mamoru Masaki has been appointed Aerodynamicist with Curtiss-Wright Corporation at Buffalo.

Robert MacLarren is the new editor of the magazine *Air Age*, having formerly been West Coast Manager and News Editor of *Model Airplane News*.

Warren A. Meyer, formerly with The Glenn L. Martin Company, has become an Instructor in the Department of Aeronautical Engineering at the University of Texas.

Albert E. Mitchell is Chief Draftsman in the Aircraft Division of York Research Corporation.

Charles K. Razak is now Associate Professor of Aeronautical Engineering at the University of Wichita.

William J. Reznicek is an Engineering Draftsman with Douglas Aircraft Company, Inc.

Joseph J. Russell has been advanced to the position of Works Manager at the Fort William Branch of Canadian Car & Foundry Company.

Lester W. Smith, Jr., has enlisted in the U.S. Army Air Forces.

Wesley L. Smith, formerly Vice-President and General Manager of Virginia Rubatex Corporation, has been elected Vice-President of Great American Industries, Inc.

Edward N. Stevensen, recently with Curtiss-Wright Corporation, has enlisted in the U.S. Marine Corps.

Foster B. Stulen is now Chief Structural Engineer in the Propeller Division of Curtiss-Wright Corporation.

John R. Weske, recently serving as a Consultant in the General Engineering Laboratories of the General Electric Company, while on leave of absence from the Case School of Applied Science where he was Associate Professor of Aerodynamics, has returned to the school as Professor of Aerodynamics.

Thomas J. Zilka has joined Boeing Aircraft Company as a Flight Instrumentation Engineer.

Members Elected

The following applicants for membership or applicants for change of previous grade have been admitted to membership in the grades indicated since the publication of the list in the last issue of the REVIEW.

Transferred to Associate Fellow Grade

Chapline, George F., B.Sc.; Comdr., U.S.N.

Foster, Edward Elden, S.B. in AeE.; Chief Structures Engineer, Airplane Div. Curtiss-Wright Corp.

Kalinowski, Ludwig Boleslaw, M.S. in Ae.E.; Asst. Chief Engineer, Edo Aircraft Corp.

Luttman, Horace Charles, B.A.; Asst. Chief Inspector Aircraft, British Air Commission.

Martin, Erle, B.S. in E.E.; Engineering Manager, Hamilton Standard Propellers Div., United Aircraft Corp.

Reissner, Eric, Ph.D.; Asst. Prof. Math., Mass. Inst. of Tech.

Skelton, Eric, B.Sc.; Lt., Air Engineer Officer, Royal Navy.

Elected to MEMBER Grade

Ballaseyus, Albert Charles, B.S. in M.E.; Supervising Research Engineer, N.R.C. Project, Univ. of California.

Banta, Perry M., B.S. in E.E.; Administrative Engineer, U.S. Army Air Forces.

Bettega, Francis Eugene, B.Ae.E.; Chief Salvage & Structural Engineer, Willys Overland.

Burdick, Perry Champlain, Stress Engineer, Goodyear Aircraft Corp.

Chapman, Arthur E., Chief, Flight Operations, Goodyear Aircraft Corp.

Cowling, J. G., S.B. in M.E.; Asst. Chief Project Engineer, Lockheed Aircraft Corp.

Cox, William Joseph, B.S. in M.E.; Assoc. Aero. Engineer, Naval Aircraft Factory.

Drew, John Lawrence, B.S. in A.E.; Engineering Analyst, Curtiss-Wright Corp.

Droegemueller, Edwin Alfred, Project Engineer, Pratt & Whitney Aircraft Div., United Aircraft Corp.

Fedan, S. H., B.S.; Executive Engineer, Bartlett Hayward Div., Koppers Co.

Francis, David Austin, B.S.; Asst. to Mgr., Aircraft Instruments Dept., Sperry Gyroscope Co., Inc.

Furnas, Clifford Cook, Ph.D.; Director of Research, Curtiss-Wright Corp.

Hafkenschiel, Joseph H., M.D.; Director of Eighth Altitude Training Unit, Army Air Base.

Hugli, Wilfred Charles, Jr., M.E.; Executive Engineer, Stevens Inst. of Tech.

Jamieson, Charles M., B.S. in Ae.E.; Chief Engineer, Culver Aircraft Corp.

Jones, Jack C., Experimental & Engineering Test Pilot, Airplane Div., Curtiss-Wright Corp.

Jovanovich, Dragoljub Kosta, B.A.E.; Consulting Engineer, Pecker, Simpson, Gladeck & Associates.

Keen, Walter Hughes, Jr., Lt. Comdr., U.S.N., LTA Design, Bureau of Aeronautics, Navy Dept.

Kelly, Curtis, B.S. in AeE.; Assoc. Aero Engineer, Matériel Command, War Dept., U.S. Army Air Forces.

Kimmey, John Warren, B.Ae.E.; Asst. to Mgr., Aircraft Instruments Dept., Sperry Gyroscope Co., Inc.

Kraft, Hans, Dipl. Ing.; Research Engineer, General Electric Co.

Langewiesche, Wolfgang, M.A.; Test Pilot, Cessna Aircraft Co.; Articles for *Air Facts* magazine.

Large, Frank Earl, A.B.; Chief Tool Designer, Research Div., Bell Aircraft Corp.

Lillyblad, Robert Harry, B.E.E.; Chief Engineer, Camfield Mfg. Co.

Mace, Roger Meredith, Flight Lt., Test Pilot & Aero. Engineer, R.C.A.F.

Marcin, Benjamin, Aero. Engineer, Airplane Div., Curtiss-Wright Corp.

McKinney, Richard Irwin, Group Leader, Master Layout, Fleetwings Div., Kaiser Cargo, Inc.

Mortensen, Martin Peter, M.E.; Sr. Layout (Design), Kellett Autogiro Corp.

Murray, Allan Brown, M.Sc.; Asst. Director of Experimental Towing Tank, Stevens Inst. of Tech.

Olmstead, Edwin Harrison, S.M.; Chief Experimental Engineer, Lawrance Engineering & Research Corp.

Peck, Volney Ames, B.S. in A.E.; Preliminary Design Engineer, Consolidated Vultee Aircraft Corp.

Perkins, Courtland Davis, M.S. in Ae.E.; Assoc. Aero. Engineer, Matériel Command, U.S. Army Air Forces.

Phemister, William Ian, B.S. in M.E.; Photo Reproduction Supervisor, Victory Aircraft Ltd., Canada.

Ragsdale, William Hudson, Field Engineer, AC Spark Plug Div., General Motors Corp.

Ringle, Robert E., Asst. to Chief Project Engineer, Bell Aircraft Corp.

Rodman, Wilmot L., B.S.; Chief of Structures, Consolidated Vultee Aircraft Corp.

Saunders, Seymour Gordon, B.S. in Chem.; Executive Staff, Dodge Div., Chrysler Corp.

Scalzi, John B., S.M. in C.E.; Weight Structural Engineer, Airplane Div., Curtiss-Wright Corp.

Sparrow, Stanwood W., B.S. in M.E.; Engineer-in-Charge of Tests, Aviation Div., Studebaker Corp.

Wells, Edward Curtis, B.A.; Chief Engineer, Boeing Aircraft Co.

Whitaker, Uncas Aeneas, President, Aircraft-Marine Products, Inc.

Transferred to MEMBER Grade

Denzin, Edward C., B.S. in Ae.E.; Project Stress Engineer, Northrop Aircraft, Inc.

Gordon, Haskell Robert, B.S. in Ae.E.; Aero. Engineer, Naval Air Experimental Station, Philadelphia.

Luskin, Harold, B.S. in A.E.; Flight Test Engineer, Douglas Aircraft Co., Inc.

Sokol, Max, B.S.E.; Chief Design Engineer, H. J. Heinz Co.

Speas, R. Dixon, B.S.; Asst. to Vice-Pres., Engineering, American Airlines, Inc.

Elected to Industrial Member Grade

Bunnell, John W., Chief Inspector, Jacobson & Co., Inc.

Farnsworth, Philip Searle, Standards Engineer, Pratt & Whitney Aircraft Div., United Aircraft Corp.

Schaefer, Henry Frederick, Jr., B.S. in C.E.; Development Engineer, American Seating Co.

Elected to Technical Member Grade

Amuedo, Arthur Royal, Jr., B.S. in Ae.E.; Asst. Aero. Engineer, Ames Aero. Lab., N.A.C.A.

Arcarese, Carlo J., Layout Draftsman, Airplane Div., Curtiss-Wright Corp.

THE MAN BEHIND THE MAN BEHIND THE STICK

Courtesy of Pan American Airways

With trust in a man on the other side of the world!

On the other side of the world—11,000 or more miles away—is a man who "checked out" this plane. Both the Transport Pilot and his crew have forgotten his name, yet they are trusting their lives to his skill.

* * * *

Mechanics and ground crewmen are truly the forgotten men in World War II. They go without praise yet they do their tasks well, consistently. We like to feel that their qualities—performance and dependability—are found in Resistoflex products, too.

Years of development have produced instrument, hydraulic and vacuum hose and hose assemblies that are ounces lighter yet have a tensile strength far superior to similar lines. They are flexible, stand up under millions of vibrations, under severe flexing and shock-loads.

The glass-smooth inner surface of Resistoflex hose reduces turbulence and friction — is chemically inert — does not gum or erode in hydraulic fluids, lubricants or even in fuels having the highest aromatic contact.

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RESISTOFLEX FEATURES:

SPECIFICATIONS—Complies with applicable Army and Navy specifications.
SIZES—Supplied in all standard diameters and lengths.
LIGHTER AND STRONGER—Ounces lighter . . . has tensile strength far greater than similar lines.
FLEXIBILITY—Permits compact design, less room to install.
PERMANENT, FULL FLOW—The chemically inert inner surface reduces turbulence and friction.
VIBRATION PROOF—Withstands millions of vibrations, flexings, shock-loads.

LOW AND MEDIUM PRESSURE INSTRUMENT, HYDRAULIC AND VACUUM HOSE ASSEMBLIES —MANOMETER TUBING, DIPPED AND MOLDED SPECIALTIES.

RESISTOFLEX

RESISTOFLEX CORPORATION, BELLEVILLE, NEW JERSEY

Bernstein, Maurice Saul, Layout Man, Sikorsky Aircraft Div., United Aircraft Corp.

Blanton, John William, B.S. in M.E.; Research Engineer, Bell Aircraft Corp.

Britton, Sidney Leon, B.S. in A.E.; Weights Engineer, Fleet Aircraft Ltd., Canada.

Cordas, Albert Carl, Stress Analyst, G & A Aircraft Corp.

Diederich, Franklin Wolfgang, B.M.E.; Instructor, New York Univ.

Doak, Marthon, Jr., Aero. Stress Analyst, Bristol Aeronautical Corp.

Donnen, Earl Martin, B.S. in M.E.; Detail Engineer, Boeing Aircraft Co.

Eichhorn, Howard W., B.S.E.; Structural Designer & Stress Analyst, Fleetwings Div., Kaiser Cargo, Inc.

Fingerle, Forest W., Layout Draftsman, Consolidated Vultee Aircraft Corp.

Flatt, Joseph, B.Ae.E.; Assoc. Aero. Engineer, U.S. Army Air Forces.

Grautoff, Walter Bernard, Jr., Assoc. Engineer, C.A.A.

Hall, Dudley, M.E.; Sr. Project Engineer, Northwest Airlines, Inc.

Huntzinger, Richard Stauffer, B.S. in M.E.; Engineering Draftsman, The Glenn L. Martin Co.

Huset, Elmer Alfred, Jr., B.C.E.; Project Engineer, Northwest Airlines, Inc.

Johnston, John Patrick, Professional Engineer, Engineering Div., Douglas Aircraft Co., Inc.

Kaufman, Norman Edward, Liaison Engineer, Airplane Div., Curtiss-Wright Corp.

Keefer, Karl H., B.S. in Ae.E.; Stress Analyst, Airplane Div., Curtiss-Wright Corp.

Klawans, Bernard Bertram, B.S. in A.E.; Jr. Aero. Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Krusi, John Bernhard, B.A.E.; Engineer, Airplane Div., Curtiss-Wright Corp.

Lester, William A., Power Plant Design Engineer, Bell Aircraft Corp.

McKee, Dale William, A.E.; Design Layout, Bell Aircraft Corp.

Mertens, Donald Arthur, Group Leader Fixed Equipment, Bell Aircraft Corp.

Mosbacher, Karl Joseph, Jr., B.S. in M.E.; Application Engineer, General Electric Co.

Myers, Frank Anthony, Jr., Sr. Layout Draftsman, Consolidated Vultee Aircraft Corp.

Pederson, William John, Engineer, Universal Moulded Product Corp.

Pepping, Raymond Austin, M.S.; Lt. U.S. Army Air Forces, Engineer, Engineering Div., Aircraft Lab., Matériel Center, Wright Field.

Powell, James Leslie, Jr., B.S. in Ae.E.; Experimental Flight Test Weight Engineer, Airplane Div., Curtiss-Wright Corp.

Pribyl, David Simpson, B.Ae.E.; Materials Engineer, H. J. Heinz Co.

Richart, Frank E., Jr., B.S. in M.E.; Specialty Engineer, U.S.N.

Rosenberg, Reinhardt Mathias, B.S.; Flutter Engineer, Bell Aircraft Corp.

Sandahl, Carl August Jr., Asst. Aero. Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Thomas, James Akin, Jr., C.E.; U.S.N.R.

Trimborn, Robert J., Weight Control Engineer, Asst. Chief, Grumman Aircraft Engineering Corp.

Wilkie, James Sadler, B.S. in A.E.; Test Engineer, Republic Aviation Corp.

Zech, William A., B.S. in M.E.; Stress Analyst, Airplane Div., Curtiss-Wright Corp.

Ziegler, Jean Leroy, Test Pilot, Airplane Div., Curtiss-Wright Corp.

Transferred from Student to Technical Member Grade

Brown, Joel Eugene, B.S. in A.E.; Engineering Asst., El Segundo Div., Douglas Aircraft Co., Inc.

Carvey, Thomas Banks, Jr., A.B. in M.E.; Aerodynamicist, Globe Aircraft Corp.

Cornwell, Roy Stribling, B.Ae.E.; Ens., U.S.N.R.

Cotter, William Edward, B.S. in Ae.E.; Aerodynamicist, Avion, Inc.

Cotton, Charles Bill, B.S. in Ae.E.; Jr. Aero. Engineer, Aircraft Engine Research Lab., N.A.C.A.

Fogel, Timothy John, A.B. in M.E.; Flight Engineer, Pan American Airways System.

Fuller, George Milton, B.S. in Ae.E.; Trainee, Lockheed Aircraft Corp.

Gendron, Willard Loeffler, B.S. in M.E.; Industrial Engineer, The Glenn L. Martin-Nebraska Co.

Gray, Ian Alexander, B.Ae.E.; Service Engineer, Canadian Pacific Airlines Ltd., Canada.

Hanson, Carl Mellren, Jr. Engineer, El Segundo Div., Douglas Aircraft Co., Inc.

Head, Richard Moore, M.S.; Research Engineer, Lockheed Aircraft Corp.

Higley, Robert Butler, B.Ae.E.; Ens., U.S.N.R.

Hoblitzell, Carl Minor, B.S. in Ae.E.

Holdahl, Robert Austin, B.Ae.E.; Flight Research Engineer, Bell Aircraft Corp.

Hsiao, Kuang Hao, M.A.; Teaching Asst., Stanford Univ.

Judin, James Palmer, B.S. in Ae.E.; Draftsman, Univ. of Minnesota.

Klampe, Dean G., B.Ae.E.; Aerodynamics Group, Airplane Div., Curtiss-Wright Corp.

Knight, Richard Earl, B.S. in Ae.E.; Jr. Aero Engineer, Chance Vought Aircraft Div., United Aircraft Corp.

Lueck, David William, B.S. in Ae.E.; Sr. Asst. Aerodynamics, Lockheed Aircraft Corp.

Mastandrea, Emil James, Aero. Engineer, Hoosier Aircraft.

Michelson, Irving, B.S. in Ae.E.; Stress Analyst, Sikorsky Aircraft Div., United Aircraft Corp.

Parsons, Robert Smith, B.S. in Ae.E.; Design Draftsman, Bell Aircraft Corp.

Petrein, Richard Jule, B.A.E.; 2nd Lt., U.S. Army Air Forces.

Powers, John Orin, B.S. in M.E.; Graduate Engineer Trainee, Pratt & Whitney Aircraft Div., United Aircraft Corp.

Rosenfeld, Howard Morton, B.S. in Ae.E.

Shevchenko, Richard Platon, B.Ae.E.; Graduate Engineering Trainee, Pratt & Whitney Aircraft Div., United Aircraft Corp.

Solomon, William, B.A.E.; Jr. Aero. Engineer, Langley Mem. Aero Lab., N.A.C.A.

Spreiter, John Robert, B.Ae.E.; Jr. Aero. Engineer, Ames Aero. Lab., N.A.C.A.

Stein, Manuel, B.S. in M.E.; Jr. Aero. Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Sward, Marvin Richard, B.Ae.E.; Ens., U.S.N.R.

Tendeland, Thorval, B.Ae.E., Jr. Aero. Engineer, Ames Aero. Lab., N.A.C.A.

Waite, Frederick Crawford, Jr., B.S. in A.E.; Ens., U.S.N.R.

Wetzel, Joseph George, B.S. in Ae.E.; Apprentice Engineer, Panair de Brasil, Brazil.

White, Frederick Milton, B.S.; Engineering Asst., Vega Aircraft Corp.

Weining, Roger Franklin, B.Ae.E.; Jr. Aero. Engineer, Aircraft Engine Research Lab., N.A.C.A.

Elected to Affiliate Grade

Capriola, Ralph L., Loftsman, Leadman, Brewster Aeronautical Corp.

Highleyman, Daly, Industrial Engineer, Consolidated Vultee Aircraft Corp.

Ravashier, Minnie, Engineering Asst. & Secy., Republic Aviation Corp.

Necrology

Harold Caminez

Harold Caminez, an Associate Fellow of the Institute and a member of the Engineering Staff of the Lycoming Division of the Aviation Corporation, was among those killed in an accident to a transport airplane in which he was a passenger, near Bowling Green, Ky., on July 28. He was 45 years of age.

In 1917 and 1918 Mr. Caminez was employed by the Curtiss Airplane & Motor Company in Garden City, Long Island, as a draftsman and served in the U.S. Naval Reserve in 1919 and 1920, receiving his degree of Mechanical Engineer from Cornell University in 1920. He transferred to the engineering division of the U.S. Army Air Corps at McCook Field, Dayton, O., designing, testing, and analyzing aircraft engines and taking charge of the Liquid-Cooled Engine Design Branch in 1924. In 1925 he organized the Fairchild-Caminez Engine Corporation, serving until 1929 as Vice-President and Chief Engineer, after which he joined the Allison Division of General Motors. He was in charge of the design and development of a series of liquid-cooled engines, especially the Allison V-1710 aircraft engines for the Navy, redesigning it to meet the U.S. Army Air Corps specifications.

Between 1936 and 1939 he conducted his own enterprises as a consulting engineer and independent aircraft-engine designer, also inventing and developing the Aero-Thread screw system. In 1939, he became executive engineer of

New Uses for SHENANGO-PENN *Centrifugal Castings*

WARTIME production demands have led aviation engineers to a greater reliance upon centrifugally cast products. Parts formerly forged are now being turned out in rapidly revolving molds. In many cases, product performance has improved; in all cases, finished production time has been reduced and critical materials have been conserved.

Shenango-Penn castings can probably be used wherever wheels turn or where wearing or corrosion exist. Because the process is so flexible, it is possible to furnish flanges and to work out unusual shapes and sizes. Our standard alloys meet all Army, Navy and Air Corps specifications—and are constantly tested and checked in our own laboratory.

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THE 5TH FREEDOM

The life of every American will be fuller when, in the post war world, the amazing developments of modern aviation will be available to bring new freedom from barriers of distance. Among these developments is the constant speed, light weight Wickwire Automatic Propeller with its *fully* automatic pitch change—contributing to the speed, dependability and simplicity of family flying.

WICKWIRE SPENCER AVIATION CORPORATION
Blue Island, Illinois
(Subsidiary of Wickwire Spencer Steel Company)

Air Associates, Inc., and joined Lycoming as Project Engineer in 1941.

Mr. Caminez was the author of numerous technical papers and articles that were published in engineering journals and presented before scientific societies on aircraft engines, stress analysis, and engine-cooling problems.

Montgomery Knight

Montgomery Knight, an Associate Fellow of the Institute, died on July 25, in his 43rd year, after an illness of several months. He had been Director of the Daniel Guggenheim School of Aeronautics and Professor of Aeronautical Engineering at the Georgia School of Technology since 1930.

Professor Knight was born in Lynn, Mass., on February 22, 1901, and was graduated from the Massachusetts Institute of Technology in 1922, also taking graduate courses at Harvard and Johns Hopkins. In 1925 he entered the service of the National Advisory Committee for Aeronautics as an aeronautical engineer at Langley Field, Va. and was engaged there in aerodynamic research until 1930. He was among the leading authorities in helicopter design and was the author of numerous technical reports and notes published by the N.A.C.A. and various aeronautical publications.

In his work at Georgia Tech., Professor Knight was responsible for the direction and development of the aeronautical curricula and research activities of the Daniel Guggenheim School of Aeronautics.

Frederick Bryton Thompson

Frederick Bryton Thompson passed away on July 20, after a long illness, at his home in Detroit. He was the author and publisher of numerous books on aerodynamics, aircraft, engines, meteorology, aerial navigation, and civil air regulations. He was the owner of the Thompson Aviation Publishers, which he established in Detroit in 1930.

Mr. Thompson was a native of Toledo, O., where he was born on April 18, 1884. He was largely self-educated, his studies of correspondence courses leading him eventually to the development of home-study courses in which he endeavored to improve the existing techniques in that field. He enlisted in the U.S. Coast Artillery during the first World War, after which he served as a commercial ground-school instructor, also being the author and compiler of ground-school courses. He acted as an instructor in meteorology and aerial navigation in the evening high school at Cass Technical High School, Detroit.

Lawrence A. Kirkland

Lawrence A. Kirkland, one of the best friends the Institute has had, died on July 13, 1943, in New York. Although not a member of the Institute, he was instrumental in offering to the Institute in 1934, at the suggestion of Nelson Rockefeller, offices in the R.C.A. Building at a time when the Institute had practically no funds. The Institute was one of the earliest tenants of Rockefeller Center, and during its ten years of expanding activities it had the lively interest of Mr. Kirkland and his encouragement in securing space that would be adequate not only for the offices of the Institute but for the Aeronautical Archives and its publishing activities.

Mr. Kirkland was a lawyer from South Carolina and took an important part in the restoration of Williamsburg, Va., as well as the development of Rockefeller Center.

To his widow and his son, who is in the Naval Air Service, the Institute expresses its appreciation for the helpful interest of Mr. Kirkland in its growth and success.

Personnel Opportunities

This column is for the use of individual members of the Institute seeking new connections and organizations offering employment to aeronautical specialists. Any member or organization may have requirements listed without charge by writing to the Secretary of the Institute.

WANTED

Aeronautical Engineers urgently needed by Consolidated Vultee Aircraft Corporation, Fort Worth Division, to execute program of extensive development of large aircraft. Applicant must have technical training and not presently employed in essential war industries. Apply direct to 921 Lamar Street, Fort Worth, Texas.

Graduate Engineers for essential war work, opportunity for advancement and increased earnings. Aeronautical experience not necessary. Must be citizen not employed in essential war industry or have certificate of availability from the U.S. Employment Service Office or War Manpower Commission of your area. Write direct stating school, age, degree, experience, draft classification and marital status to Consolidated Vultee Aircraft Corporation, Industrial Training Division, San Diego, California.

Two Assistant or Associate Professors: (a) Instructor aircraft detail design and structural layout; (b) Instructor preliminary airplane design. Both positions are to fill existing vacancies in the regular staff. Each must have his or her degree in aeronautical engineering together with practical experience in the aircraft industry. Teaching experience desirable but not necessary. Rank and salary depend upon qualifications. Address inquiries to Dean Robert L. Mann, Spartan College of Aeronautical Engineering, Tulsa, Oklahoma.

Aeronautical Engineer: should be interested in future of air freight transportation, capable appraising current aircraft design for cargo ships and able to contribute practical ideas for sound development of efficient, coordinated air and ground handling service. Headquarters New York City; not a manufacturer. Reply stating age, draft status, qualifications, and salary to Box 192, Institute of the Aeronautical Sciences.

AVAILABLE

Structural Aeronautical Engineer, M.E., 25 years' experience military aircraft engineering including analysis, design supervision, liaison and coordination of experimental and engineering; desires responsible project with company having definite postwar work. Available within 30 days within radius of 200 miles of New York. Address inquiries to Box 194, Institute of the Aeronautical Sciences.

Aeronautical Engineer, B.A.E. and M.A.E. degrees, 3 years' practical experience as a stress analyst, designer, and an aerodynamicist; desires position as college instructor. Address inquiries to Box 193, Institute of the Aeronautical Sciences.

Aeronautical Engineer, B.S. in Ae.E., 8 years' experience, both military and commercial aircraft; experienced in all phases of design and design supervision. Desires position of staff or design engineer in controls or assistant project engineer. Position must have postwar future. Address inquiries to Box 191, Institute of the Aeronautical Sciences.

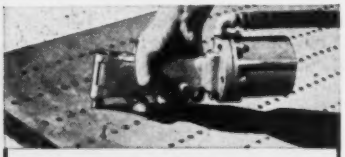
Engineer, B.S. in Ae.E., over 8 years' experience as test pilot including planning of tests and analysis of results, desires position primarily utilizing flight and engineering experience but not involving routine test flying. Some flying desirable. Address inquiries to Box 190, Institute of the Aeronautical Sciences.

Engineer, Senior Aeronautical and Physicist (Ph.D.), 15 years' experience, available as consultant. Address inquiries to Box 189, Institute of the Aeronautical Sciences.

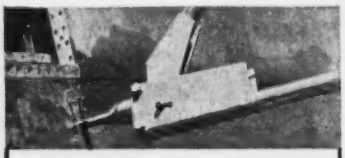
Aeronautical Engineer (B. of Ae.E.) 6 years' experience aircraft power-plant installation including design, layout, supervision, shop contact, liaison, field work for many first-rate military aircraft; also aircraft shop experience as mechanic and inspector. Desires position in supervisory design capacity or as engineering representative with power plant accessory manufacturer or as group engineer on power plants with aircraft manufacturer. Address inquiries to Box 155, Institute of the Aeronautical Sciences.

This mechanical BLIND RIVET helps all three

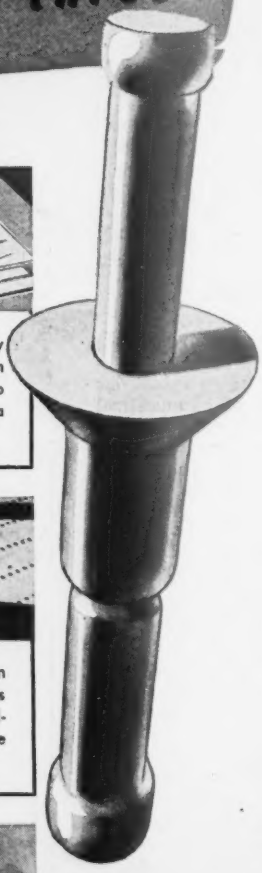
THE ENGINEER, by using Cherry Rivets, can disregard blind spots in riveted structures. He designs up to efficiency, rather than down to a manufacturing limitation.

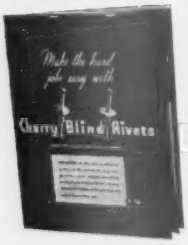


THE PRODUCTION MAN can increase output by using Cherry Rivets . . . gets a better job in blind or hard-to-get-at places. One man does the job. No bucking bar is needed.



THE SERVICE MAN does a better job in less time. Does not have to ream holes because Cherry Rivets work well with reasonable tolerance in grip length and hole size.





Get the complete story on Cherry Blind Rivets in the Handbook A-43. Request yours from Dept. A-105, Cherry Rivet Co., Los Angeles 13, Calif.

CHERRY RIVETS, THEIR MANUFACTURE AND APPLICATION ARE COVERED BY U. S. PATENTS ISSUED AND PENDING.

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